VAISALA

USER'S GUIDE

Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346

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Vaisala Oyj
P.O. Box 26
FI-00421 Helsinki
Finland

Phone (int.): +358 9 8949 1
Fax: +358 9 8949 2227

Visit our Internet pages at www.vaisala.com.

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the product.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Product Overview, introduces the features and advantages of the Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346.
- Chapter 3, Installation, provides you with information that is intended to help you install this product.
- Chapter 4, Operation, contains information that is needed to operate this product.
- Chapter 5, Modbus, contains information that is needed when operating the transmitter using the Modbus protocol.
- Chapter 6, Maintenance, provides information that is needed in basic maintenance of the product. Possible error states and situations, their probable causes and remedies are described in this chapter. This chapter also contains contact information for Vaisala Technical Support.
- Chapter 7, Calibration and Adjustment, provides you with instructions on how to calibrate and adjust Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346.
- Chapter 8, Technical Data, provides the technical data of the product.
- Appendix A, Example Installation of DMT346, illustrates an example installation of DMT346 transmitter into a process.

- Appendix B, Calculation Formulas, contains the formulas used for the calculated output quantities.
- Appendix C, Modbus Reference, describes the Modbus functions and data of the transmitter.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M210726EN-G	June 2014. This manual. Added Sensor Saturation Rate (SSR) and Sensor Temperature (T_s) to the list of Modbus registers, corrected the screenshot in completing $T_{d/f}$ adjustment, small corrections.
M210726EN-F	December 2013. Previous version. Added new command descriptions: ALSEL, AOVER, CON, DSEND, and MODS. Updated FILT command description. Updated technical specification. Various small corrections.
M210726EN-E	Applicable from transmitter software version 5.10 onward. Added Modbus protocol. Updated serial line command descriptions. Updated storage temperature range.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M010091EN	Vaisala DRYCAP® Hand-Held Dewpoint Meter DM70 User's Guide
M210185EN	Humidity Calibrator HMK15 User's Guide

Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

Safety

The DMT345/346 Dewpoint and Temperature Transmitter delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING	Ground the product, and verify outdoor installation grounding periodically to minimize shock hazard.

CAUTION	Do not modify the unit. Improper modification can damage the product, lead to malfunction, or make the product noncompliant with applicable legislation.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself to the equipment chassis before touching the boards. Ground yourself with a wrist strap and a resistive connection cord. When neither of the above is possible, touch a conductive part of the equipment chassis with your other hand before touching the boards.
- Always hold the boards by the edges and avoid touching the component contacts.

Recycling

Recycle all applicable material.

Dispose of the unit according to statutory regulations. Do not dispose of with regular household refuse.

Regulatory Compliances

EU Declaration of Conformity

Vaisala DRYCAP® Humidity and Temperature Transmitters DMT345 and DMT346 are in conformity with the provisions of the following EU directives:

- Low Voltage Directive
- EMC-Directive

Conformity is shown by compliance with the following standards:

- EN 60950-1
- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations.
- EN 550022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.

CE

Transmitters with LAN or WLAN Interface

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may

cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Transmitters with WLAN Interface

This device has been designed to operate with a 2 dBi half-wave antenna. Antennas with a gain greater than 2 dBi are prohibited for use with this device. The antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

This Class [B] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [B] est conforme à la norme NMB-003 du Canada.

Patent Notice

Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346 are protected by, for example, the following patents and their corresponding national rights:

Finnish patents 98861 and 99164, French patents 6650303 and 9504397, German patents 69418174 and 19513274, Japanese patents 3585973 and 2801156, UK patents 0665303 and 2288465, and U.S. patent 5607564.

Trademarks

DRYCAP® is a registered trademark of Vaisala Oyj.

All other trademarks are the property of their respective owners.

Software License

This product contains software developed by Vaisala. Use of the software is governed by license terms and conditions included in the applicable supply contract or, in the absence of separate license terms and conditions, by the General License Conditions of Vaisala Group.

Warranty

Visit our Internet pages for standard warranty terms and conditions: www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features and advantages of the Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346.

Introduction to DMT345 and DMT346

The DMT345 and DMT346 transmitters incorporate the advanced Vaisala DRYCAP® technology, which enables reliable and accurate dewpoint measurement. Both transmitters also feature the AutoCal function which provides excellent long term stability of the measurement.

The DMT345 is designed for measurement of relative humidity in temperatures up to 180 °C. The transmitter outputs dewpoint/frostpoint (Td/f), mixing ratio (x), volume concentration (ppm), relative humidity (RH), and temperature (T).

The DMT346 is a high-performance instrument for measurement of dewpoint and mixing ratio in temperatures up to 350 °C.

DMT346 also outputs sensor saturation rate (SSR) and temperature ($T_S = T_{Sensor}$) of the cooled Vaisala DRYCAP® sensor. Because the sensor is cooled, these values do not represent true process conditions, hence they cannot be used for process control. Nevertheless, they provide a valuable aid for calibration and for checking the cooling effect.

For quantities measured by DMT345, see Table 3 on page 20. For the optional calculated quantities measured by DMT345, see Table 4 on page 20.

For quantities measured and calculated by DMT36, see Table 5 on page 20.

Table 3 Output Quantities for DMT345

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Dewpoint/frost point temperature ($T_{d/f}$)	TDF	ºC	ºF
Mixing ratio (x)	X	g/kg	gr/lb
Relative humidity RH	RH	%RH	%RH
Temperature T	T	ºC	ºF

Table 4 Optional Output Quantities and for DMT345

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Parts per million	H2O	ppm_v/ ppm_w	ppm_v/ ppm_w
Absolute humidity (a)	A	g/m^3	gr/ft^3
Absolute humidity in standard pressure and temperature (NTP)	ANTP	g/m^3	gr/ft^3
Wet bulb temperature (T_w)	TW	ºC	ºF
Water vapor pressure (P_w)	PW	hPa	lb/in^2
Water vapor saturation pressure (P_{ws})	PWS	hPa	lb/in^2
Enthalpy (h)	H	kJ/kg	Btu/lb
Difference of T and $T_{d/f}$ (ΔT)	DT	ºC	ºF

Table 5 Output Quantities for DMT346

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Dewpoint temperature ($T_{d/f}$)	TDF	ºC	ºF
Mixing ratio (x)	X	g/kg	gr/lb
Sensor saturation rate	SSR	%	-
Sensor temperature	TS	ºC	ºF

Basic Features and Options

- Dewpoint measurement with AutoCal and sensor purge features
- Sensor warming in high humidities
- Two analog outputs and a serial interface, optional third analog output
- Installation accessories
  - DMT345: mounting flange
  - DMT346: cooling set for high temperature applications.
- User friendly display and keypad interface (optional)
- Different sensor protection options and probe cable lengths
- Support for Modbus serial communications protocol
- USB connectivity for service connections via the optional USB-RJ45 cable
- Optional modules:
  - Galvanic isolation for outputs
  - Power supply module for AC mains power
  - RS-422/485-module
  - LAN and WLAN interfaces
  - Data logger module with real time clock
  - Additional analog output module
  - Alarm relay module

Operating Principle

The DMT345/346 transmitter incorporates the Vaisala DRYCAP® sensor together with a combined temperature measurement with a PT100 resistive temperature sensor. The operating principle of the DRYCAP® sensor is based on the changes in capacitance as its thin polymer film absorbs water molecules.

The DMT345/346 transmitter measures water vapor directly and gives thus accurate results of moisture in the process. In DMT346, the sensor is cooled down with a cooling set which makes it possible to use a polymer sensor in very high temperatures, for example, +100 ... +350 °C. With this technique, no complicated sampling systems are needed. The cooling set is thermally isolated from the process itself. The temperature of the sensor is cooled down which increases the sensor saturation rate.

Sensor saturation rate and temperature are then measured, and the transmitter calculates the dewpoint and the mixing ratio on the basis of those readings.

Note that for DMT346, SSR and temperature values do not represent the process itself as they are measured after cooling. Dewpoint and mixing ratio, however, are independent of temperature and remain unchanged.

The dewpoint measurement range is -25 ... +100 °C.

Structure of the Transmitter

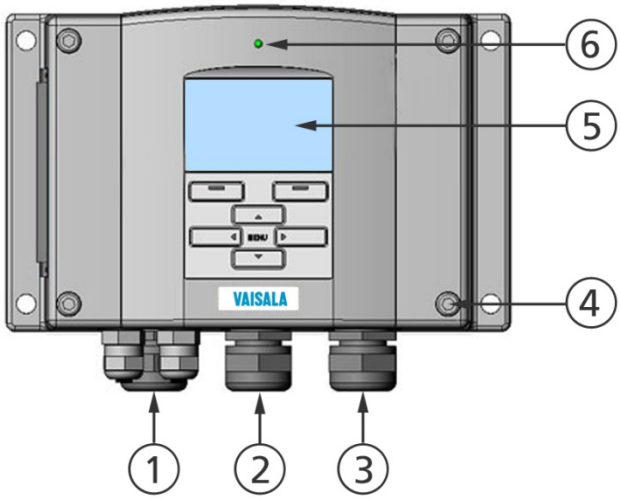


Figure 1 Transmitter Body

The following numbers refer to Figure 1 above:

1 = Signal + powering cable gland
2 = Cable gland for optional module, or WLAN antenna connector
3 = Cable gland for optional module or AC mains cable
4 = Cover screw (4 pcs)
5 = Display with keypad (optional)
6 = Cover LED

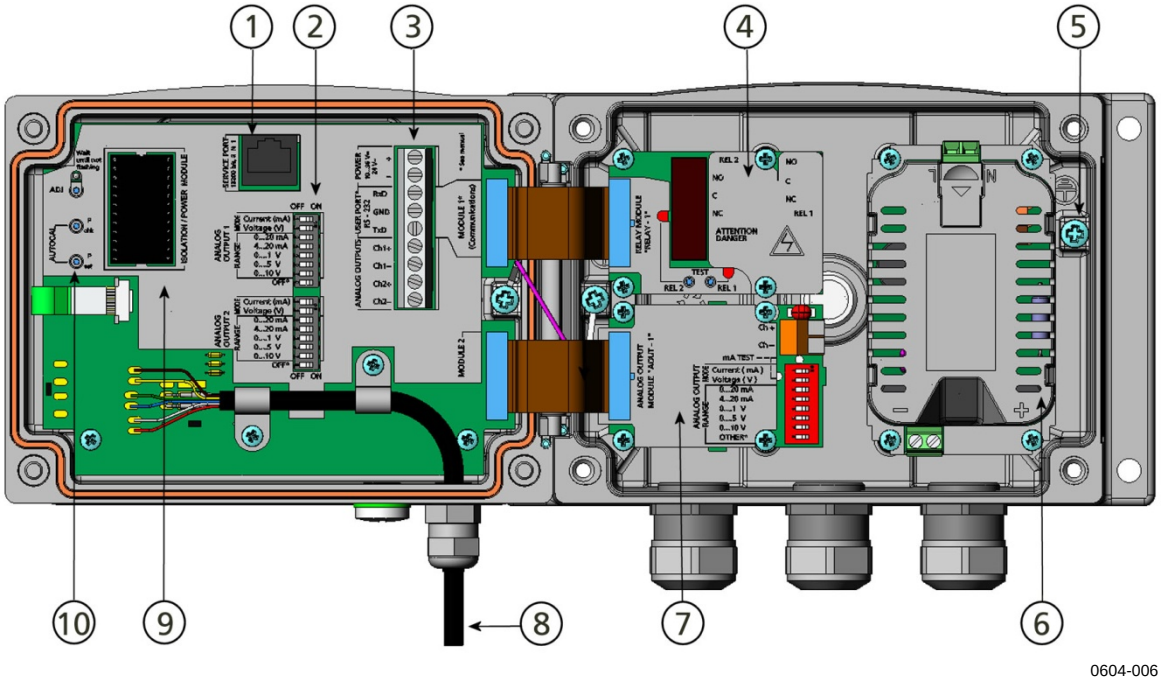


Figure 2 Inside the Transmitter

The following numbers refer to Figure 2 above:

1 = Service port (RS-232)
2 = Dip switches for analog output settings
3 = Power supply and signal wiring screw terminals
4 = Relay, data logger, RS-422/485, LAN, or WLAN module (optional)
5 = Grounding connector
6 = Power supply module (optional)
7 = Relay, data logger, or analog output module (optional)
8 = Dewpoint probe
9 = Galvanic isolation module (optional)
10 = Adjustment button and Manual AutoCal buttons with indicator LED and pressure set buttons.

Probes and Cooling Set

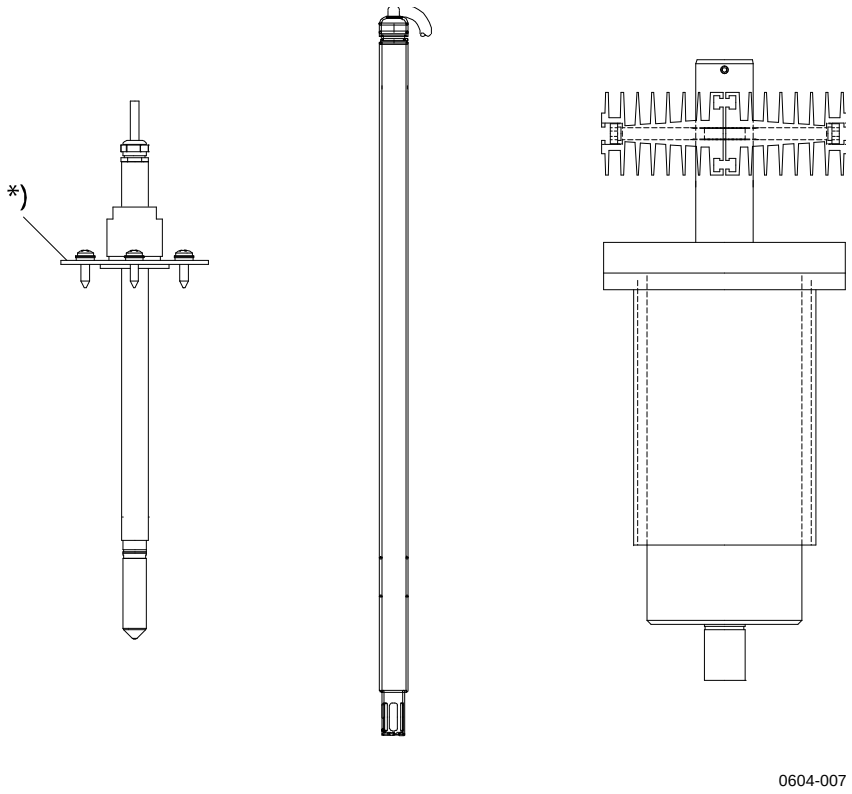


Figure 3 Probes, Cooling Set

Figure 3 above shows from left to right: DMT345 probe, DMT346 probe and the cooling set. For probe cable lengths, see Table 44 on page 165.

*) = Optional mounting flange for DMT345 probe

CHAPTER 3

INSTALLATION

This chapter provides you with information that is intended to help you install this product.

Selecting Location

Finding a suitable site for the dewpoint measurement probe is important for getting representative process or environmental measurements. The location of the probe should provide a good representation of the area of interest. Also select a location that is as clean as possible. Air should circulate freely around the sensor.

Mounting the Housing

The housing can be mounted either without the mounting plate or with optional mounting plates.

Standard Mounting without Mounting Plate

Mount the housing without the mounting plate by fastening the transmitter to the wall with 4 screws, for example, M6 (not provided).

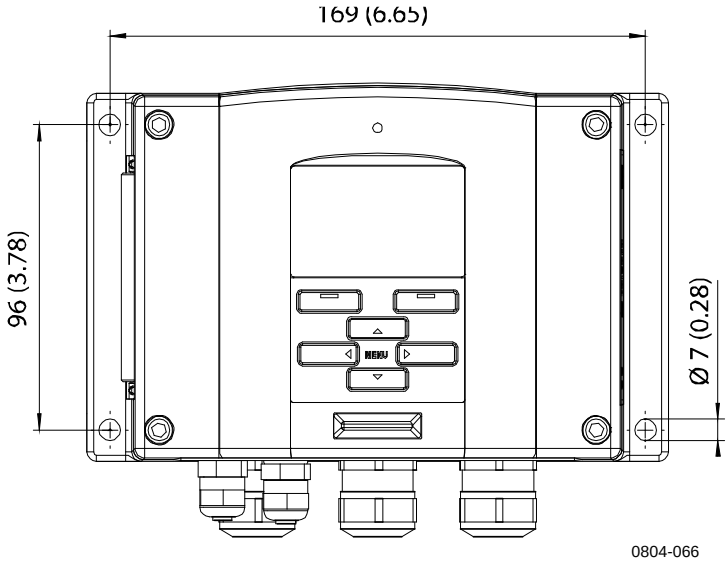


Figure 4 Standard Mounting

Wall Mounting with Wall Mounting Kit

When mounting with wall mounting kit the mounting plate (Vaisala order code: 214829) can be installed directly on wall or onto a standard wall box (also US junction box). When wiring through back wall, remove the plastic plug from the wiring hole in the transmitter before mounting.

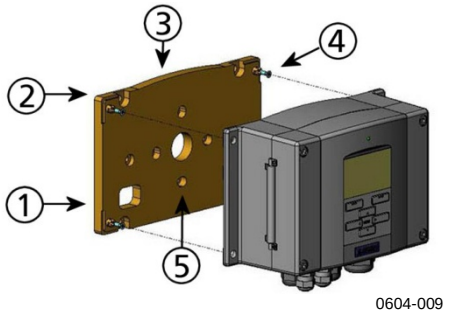


Figure 5 Mounting with Wall Mounting Kit

The following numbers refer to Figure 5 above:

1 = Plastic mounting plate
2 = Mount the plate to wall with 4 screws M6 (not provided)
3 = Arched side up
4 = Fasten the transmitter to the mounting plate with 4 fixing screws M3 (provided)
5 = Holes for wall/junction box mounting

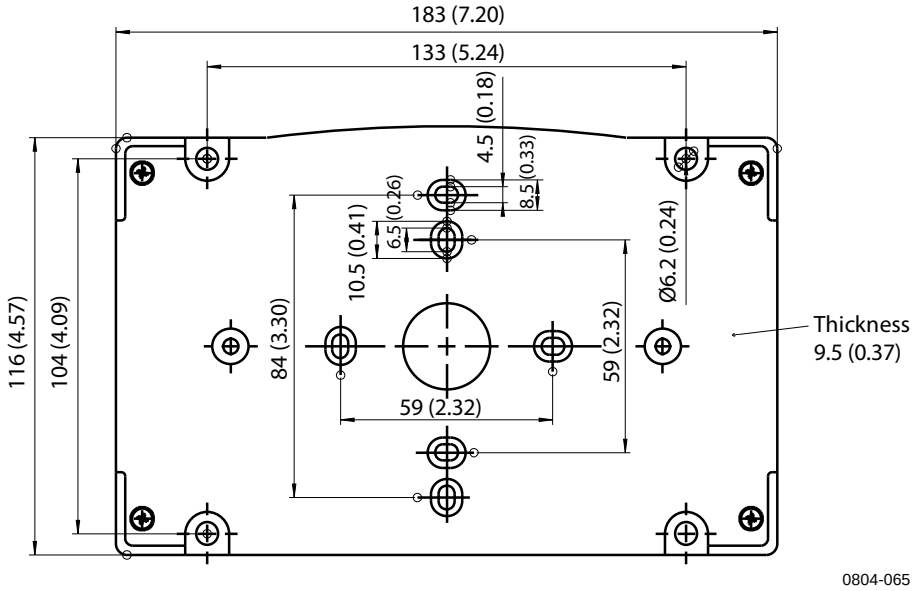


Figure 6 Dimensions of the Plastic Mounting Plate (mm/inch)

Metal mounting plate is included in rain shield with installation kit and installation kit for pole or pipeline.

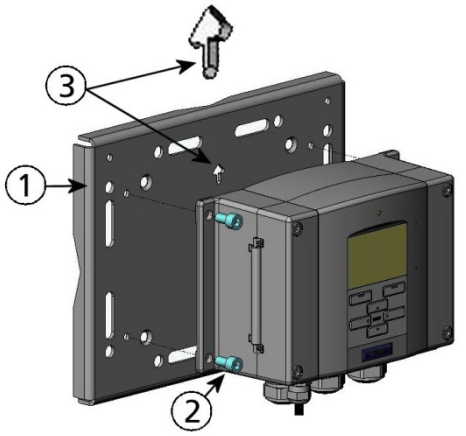


Figure 7 Mounting with Metal Wall Mounting Plate

The following numbers refer to Figure 7 above:

1 = Mount the plate to wall with 4 screws M8 (not provided)
2 = Fasten the transmitter to the mounting plate with 4 fixing screws M6 (provided)
3 = Note the position of the arrow when mounting. This side must be up when mounting.

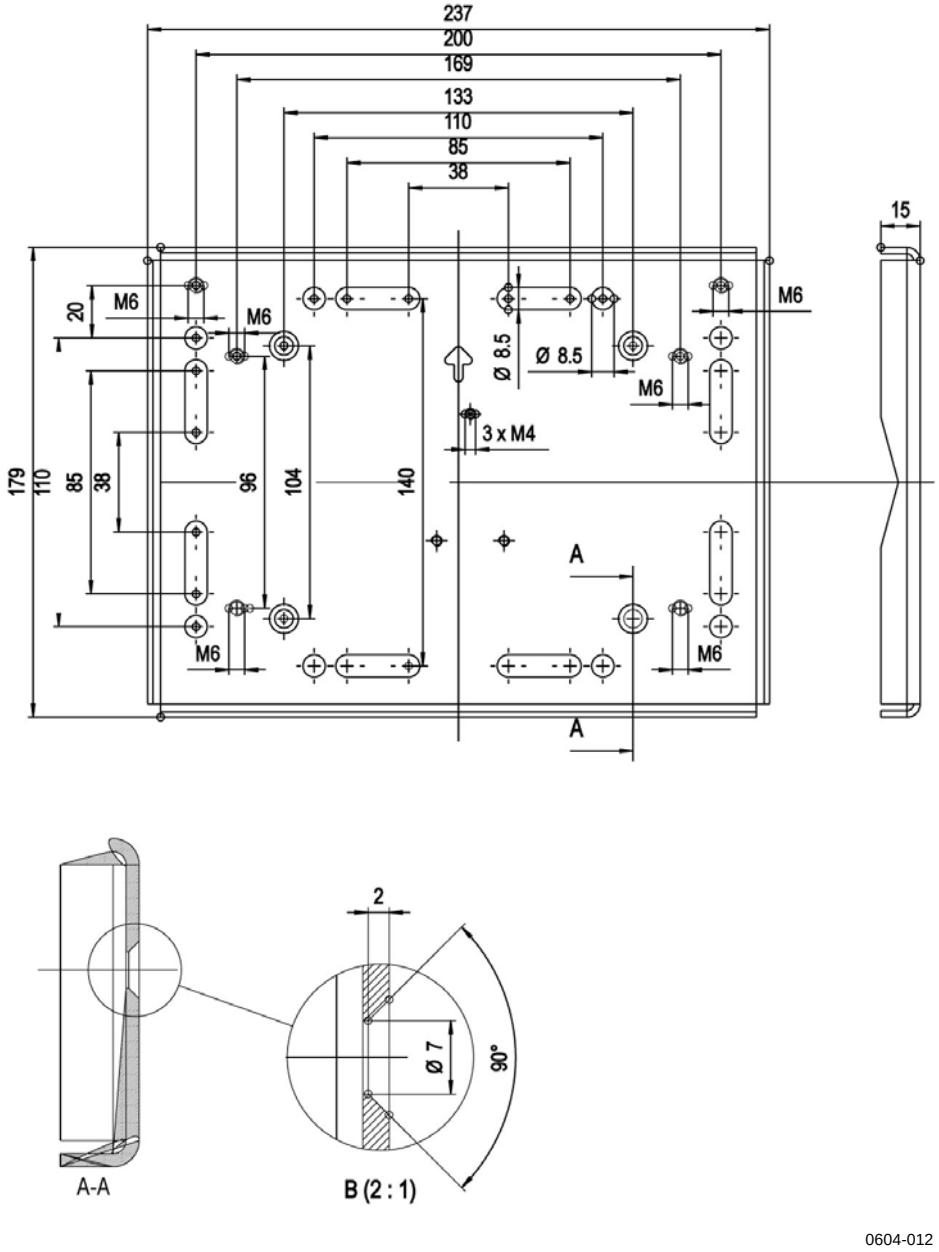
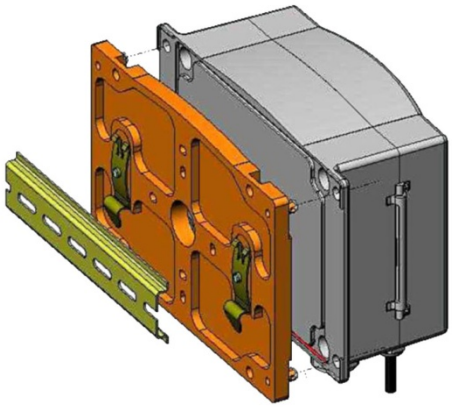


Figure 8 Dimensions of the Metal Mounting Plate (in mm)

Mounting with DIN Rail Installation Kit

DIN rail installation kit includes a wall mounting kit, 2 clip-fasteners and 2 screws M4 × 10 DIN 7985 (Vaisala order code: 215094).

1. Attach two spring holders to the plastic mounting plate by using the screws provided in the installation kit.
2. Fasten the transmitter to the plastic mounting plate with 4 screws (provided).
3. Press the transmitter onto the DIN rail so that the clip-fasteners snap into the rail.



0604-013

Figure 9 Mounting with DIN Rail Installation Kit

Pole Installation with Installation Kit for Pole or Pipeline

Installation kit for pole or pipeline (Vaisala order code: 215108) includes the metal mounting plate and 4 mounting nuts for pole mounting. When mounting, the arrow in the metal mounting plate must point upward**,** see Figure 7 on page 27.

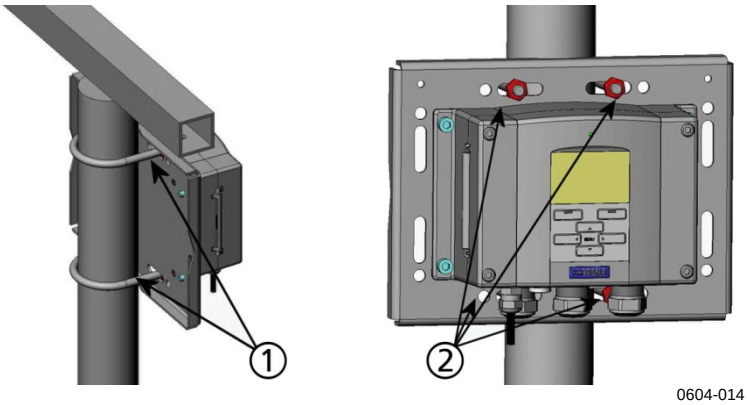


Figure 10 Vertical Pole Installation

The following numbers refer to Figure 10 above:

1 = U-bolts (2 pcs) M8 (provided) for 30 ... 102 mm poles.
2 = Mounting nuts M8 (4 pcs)

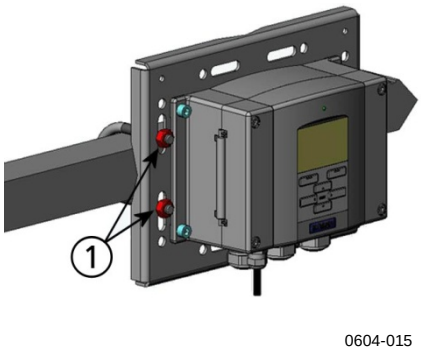


Figure 11 Horizontal Pole Installation

The following numbers refer to Figure 11 above:

1 = Mounting nuts M8 (4 pcs)

Mounting Rain Shield with Installation Kit

The rain shield is highly recommended for outdoor installations, especially for transmitters with the display/keypad option.

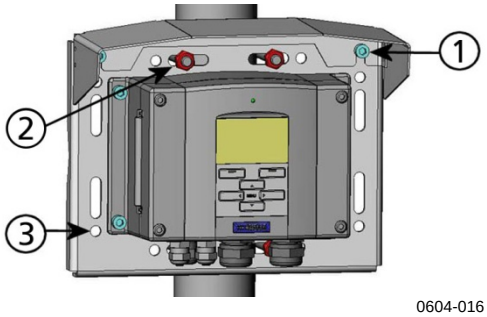


Figure 12 Mounting the Rain Shield with Installation Kit

The following numbers refer to Figure 12 above:

1 = Fasten the rain shield with the installation kit (Vaisala order code: 215109) to the metal mounting plate with 2 (M6) mounting screws (provided)
2 = Fasten the mounting plate with rain shield with installation kit to the wall or to the pole (see pole installation)
3 = Fasten the transmitter to the mounting plate with 4 fixing screws (provided)

Panel Mounting Frame

To enable a neat and dirt free embedded installation of the transmitter, a panel mounting frame is available as an option (Vaisala order code: 216038). The frame is a thin, flexible plastic frame for the transmitter, with adhesive tape on one side.

The frame is used to hide any rough edges of the installation hole, and provide a more finished look. Note that the panel mounting frame is not intended to bear the weight of the transmitter, and does not include any mounting supports.

Use the panel mounting frame as follows:

1. Use the frame as a template to mark the required size for the installation hole in the panel.
2. Cut the hole in the panel.
3. Mount the transmitter through the panel with suitable supports.
4. Remove the paper protecting the adhesive tape on the frame, and attach the frame around the transmitter. Refer to Figure 13 on page 32.

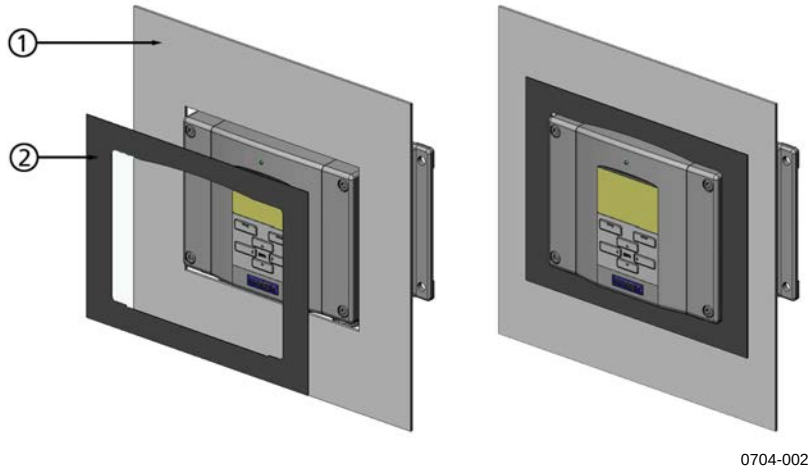


Figure 13 Panel Mounting Frame

The following numbers refer to Figure 13 above:

1 = Panel (not included)
2 = Panel mounting frame

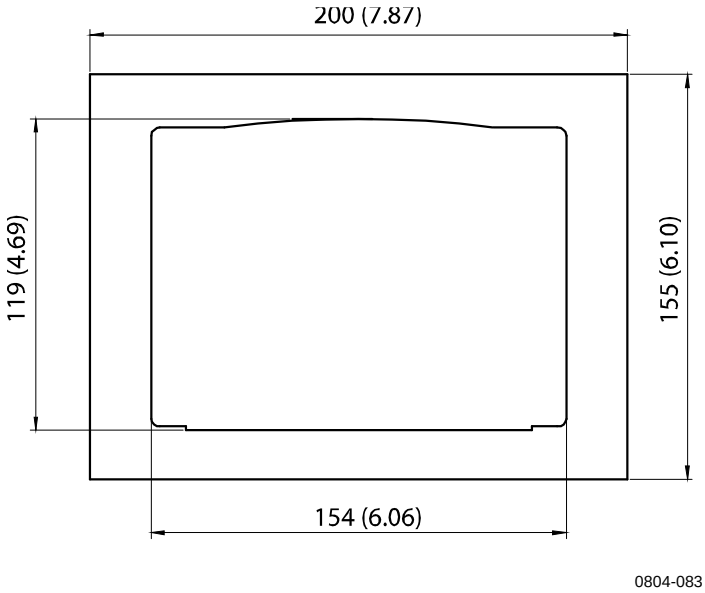


Figure 14 Panel Mounting Dimensions (mm/inch)

DMT345 Probe Mounting

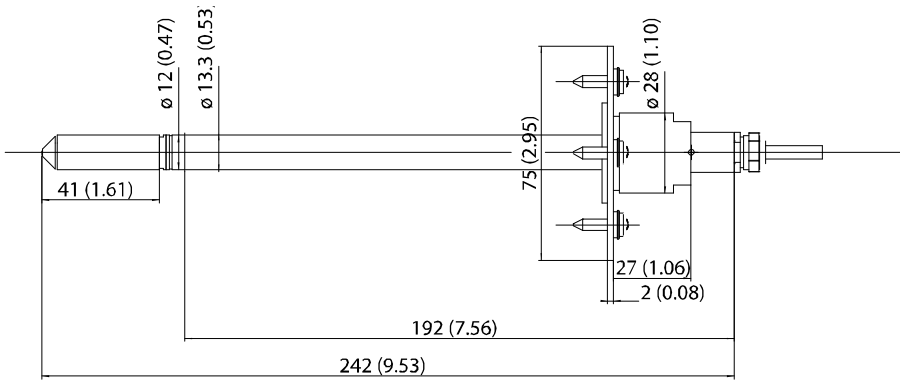


Figure 15 DMT345 Probe Dimensions (mm/inch)

Installation with Flange

The DMT345 is a small size (d = 12 mm) general purpose probe suitable for installation through process or duct walls with the flange installation kit available from Vaisala.

The duct installation kit includes a flange, a sealing ring and screws for attaching the flange to the process or duct wall (Vaisala order code: 210696).

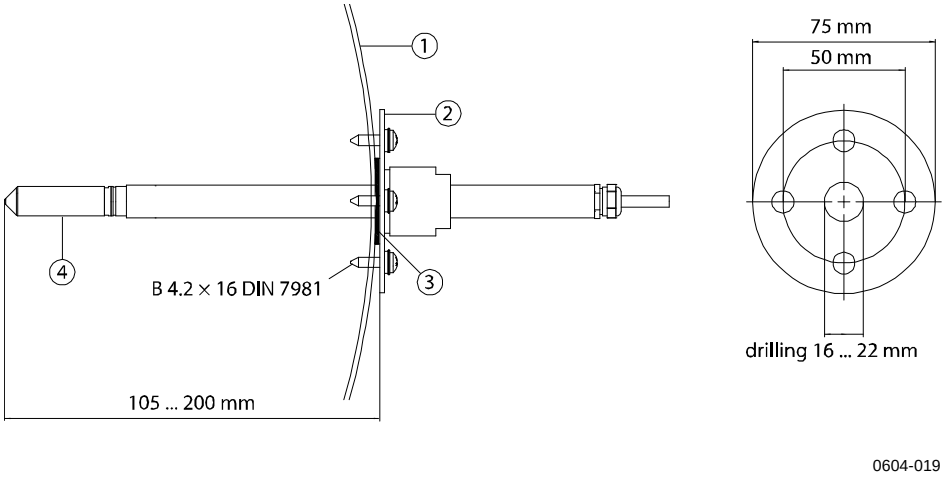


Figure 16 Flange Installation Kit

The following numbers refer to Figure 16 above:

1 = Process or duct wall
2 = Flange
3 = Sealing ring
4 = Probe

NOTE When the temperature difference between the process or duct and the surroundings is large, the probe must be installed as deep in the process or duct as possible. This prevents errors caused by heat conduction in the probe cable.

NOTE When the DMT345/346 is installed in a process with a pressure differing from the selected operating pressure at the time of ordering, please enter the pressure value of the process into the transmitter memory. You can enter the value in the following ways:

- using the display/keypad option
- using the buttons on the motherboard
- using the serial line
- using the Modbus protocol

See section Pressure Compensation Setting on page 100. If you are using Modbus, see section Configuration Registers on page 181.

DMT346 Probe and Cooling Set Mounting

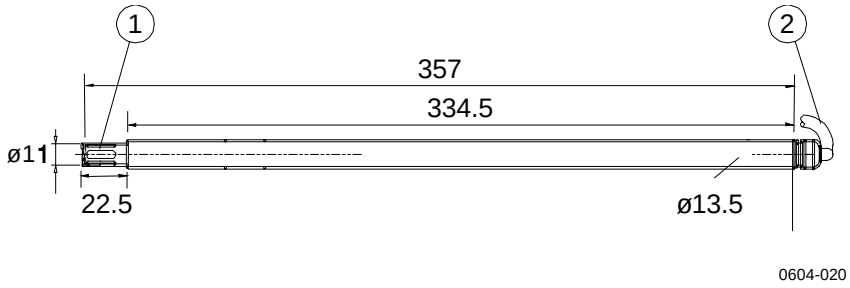


Figure 17 DMT346 Probe Dimensions (in mm)

The following numbers refer to Figure 17 above:

1 = Stainless steel grid
2 = Cable (length 2 m, 5 m or 10 m)

Description of the Cooling Set

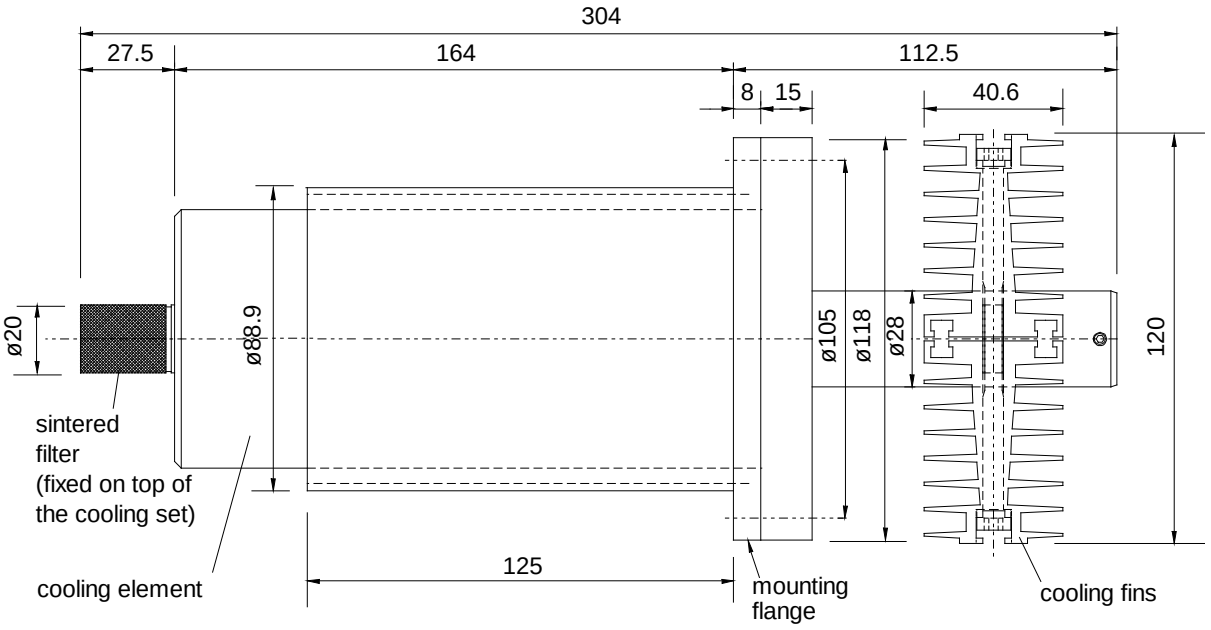


Figure 18 Cooling Set Dimensions (in mm)

The cooling set consists of a cooling element and removable cooling fins. The cooling fins are meant to be installed in applications where the process temperature and dewpoint are continuously in the range indicated in Figure 19 on page 36 (Measurement Ranges with and without the Cooling Fins). However, if there is a possibility that the dewpoint is above this range, the measurements have to be taken without the cooling fins in order to avoid condensation.

The flow rate and ambient temperature have an effect on the cooling rate. In Figure 19 on page 36, it is assumed that ambient temperature is +25 °C. When ambient temperature is raised by +10 °C, the measurement ranges with and without cooling fins rise approximately +6 °C. Correspondingly, every -10 °C change in ambient temperature changes the ranges by approximately -6 °C. It is recommended that after installing the transmitter without the cooling fins, the transmitter is allowed to stabilize and then the SSR reading is checked either from the local display or with a terminal connected to an RS line. If the SSR reading is below 20 %, it is recommended that the cooling fins are installed.

NOTE	Make sure that the upper limit of the dewpoint measurement range is not exceeded in low temperatures as this would lead to condensation.

NOTE When measuring temperature-dependent quantities, make sure that the temperature at the measurement point is equal to that of the process; otherwise, the moisture reading may be incorrect.

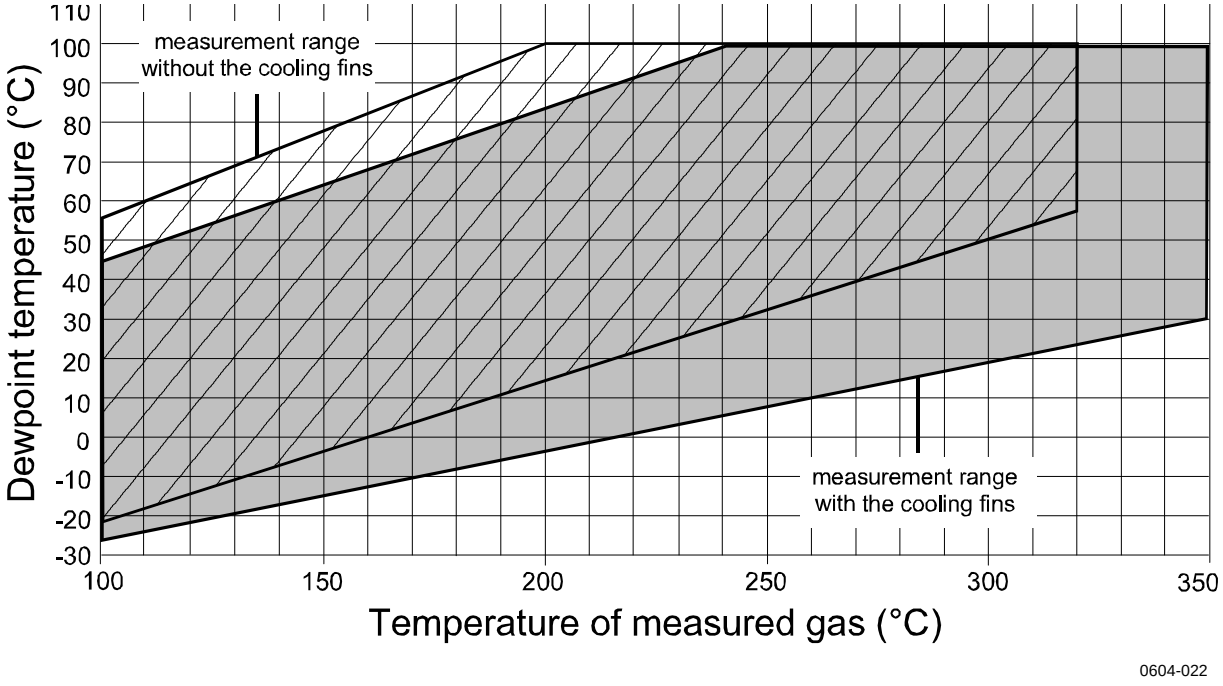


Figure 19 Measurement Ranges with and without the Cooling Fins

Parts of the Cooling Set

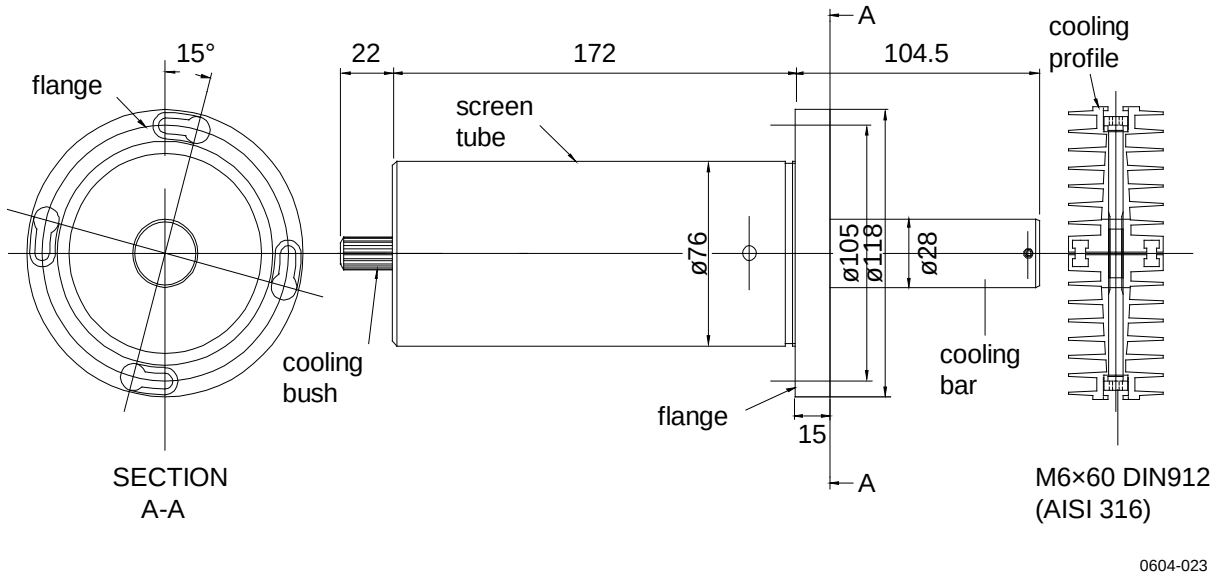


Figure 20 Parts of the Cooling Set (Dimensions in mm)

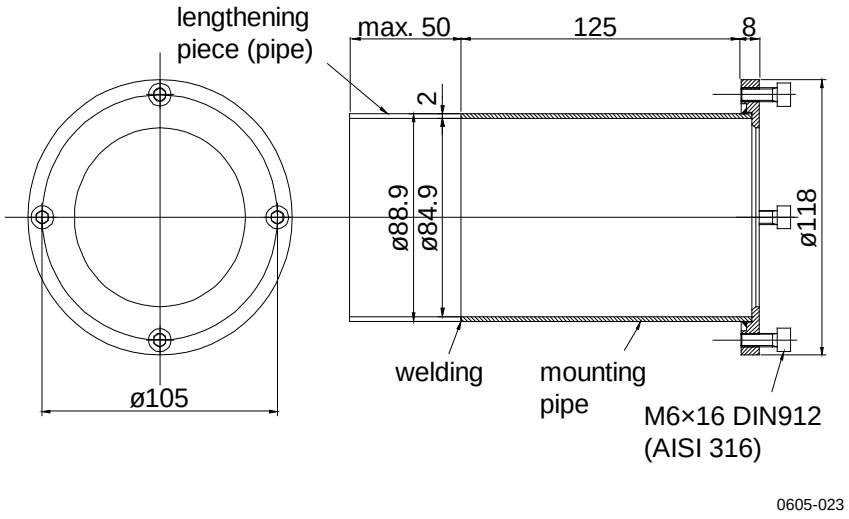


Figure 21 Mounting Flange Dimensions (in mm)

General Probe and Cooling Set Mounting Instructions

Follow these general mounting instructions to make the installation. Note the additional instructions in the following sections regarding specific situations (mounting with process shut down, mounting with process running, removing the transmitter for maintenance).

Appendix A, Example Installation of DMT346 on page 171 provides photographs of installating DMT346 transmitter through a process wall.

The probe should be installed horizontally whenever possible in order to ensure the best possible performance of the cooling set. Install the probe according to the following instructions (see also Figure 22 on page 38):

1. Make a round 89.5 + 0.5 mm hole on the process wall.
2. Weld the tube of the mounting flange tightly on the inner metal plate of the process wall. If the process wall is more than 125 mm thick, a lengthening piece (max. 50 mm) can be welded on the mounting tube (for walls thicker than 175 mm, see Figure 23 on page 38).
3. The cooling set is mounted in a vertical position. Tighten the screws properly in order to ensure a thermal contact.
4. Unfasten the locking screws on the cooling bar so that you can push the probe into the bar.

NOTE Push the probe deep enough: make sure that the marking hole meets the end of the bar.

5. Lock the probe in place by tightening the locking screws on the bar.

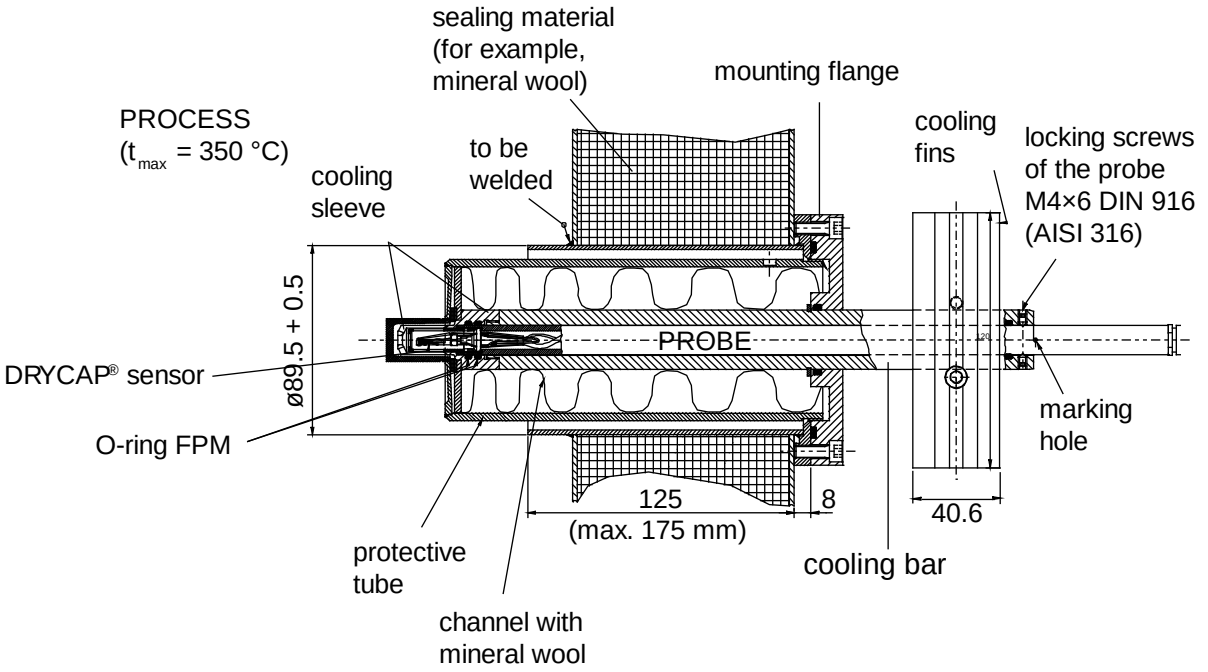


Figure 22 Installing the Probe through Process Wall

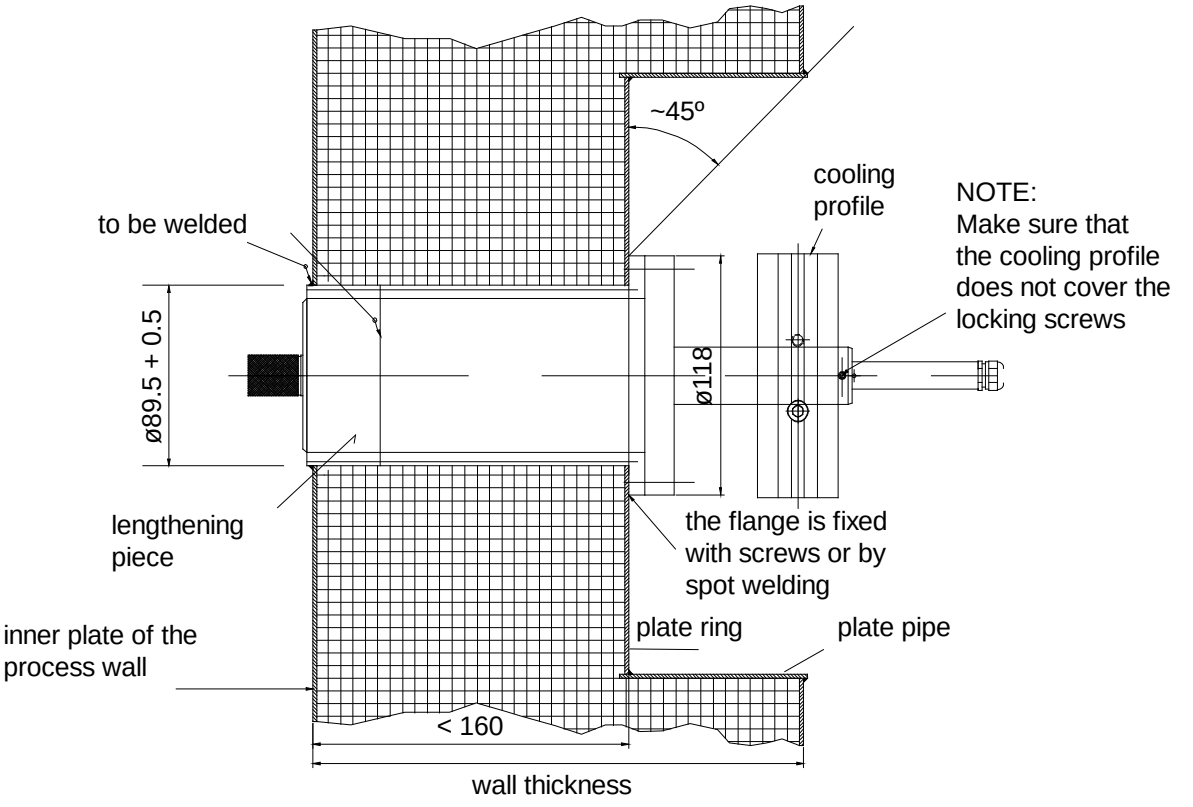


Figure 23 Installing Probe through Thick Walls

Probe and Cooling Set Mounting with Process Shut Down

Complete the entire mounting process as instructed on page 37.

Probe and Cooling Set Mounting with Process Running

Follow this procedure to reduce the amount of condensation that builds up in the installation hole.

1. First mount the cooling element (and fins) to warm it up; tightly plug the hole for the probe in the cooling element for the duration of the warmup period.
2. After a few hours, complete the installation by installing the probe.

Removing the Transmitter for Maintenance

If you remove the transmitter from the process to send it to service etc., leaving the cooling set in its place, make sure you plug tightly the hole for the probe in the cooling element. This will lessen the amount of condensation that builds up in the hole.

Wiring

Cable Bushings

A single electrical cable with a screen and three to ten wires is recommended for power and analog/serial connections. The cable diameter should be 8 ... 11 mm. The number of cable bushings depends on the transmitter options. See the following recommendations for the cable bushings:

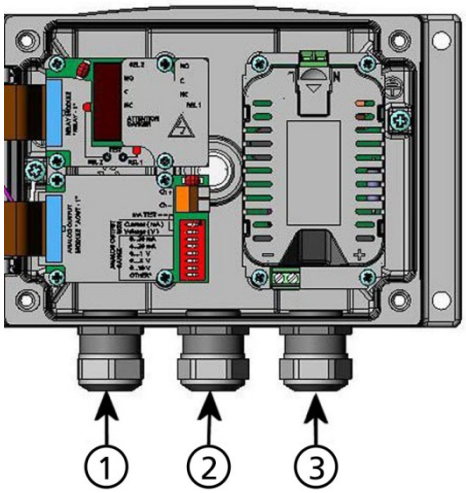


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Figure 24 Cable Bushings

The following numbers refer to Figure 24 above:

1 = Cable for signal/powering Ø8 ... 11 mm
2 = Cable for optional module Ø8 ... 11 mm
3 = Cable for optional power module Ø8 ... 11 mm

NOTE	When there is high electric noise level (for example near powerful electric motor) in the operating environment it is recommended to use shielded cable or take care that the signal cables are separated from other cables.

Cable Grounding

Ground the screen of the electrical cable properly to achieve the best possible EMC performance.

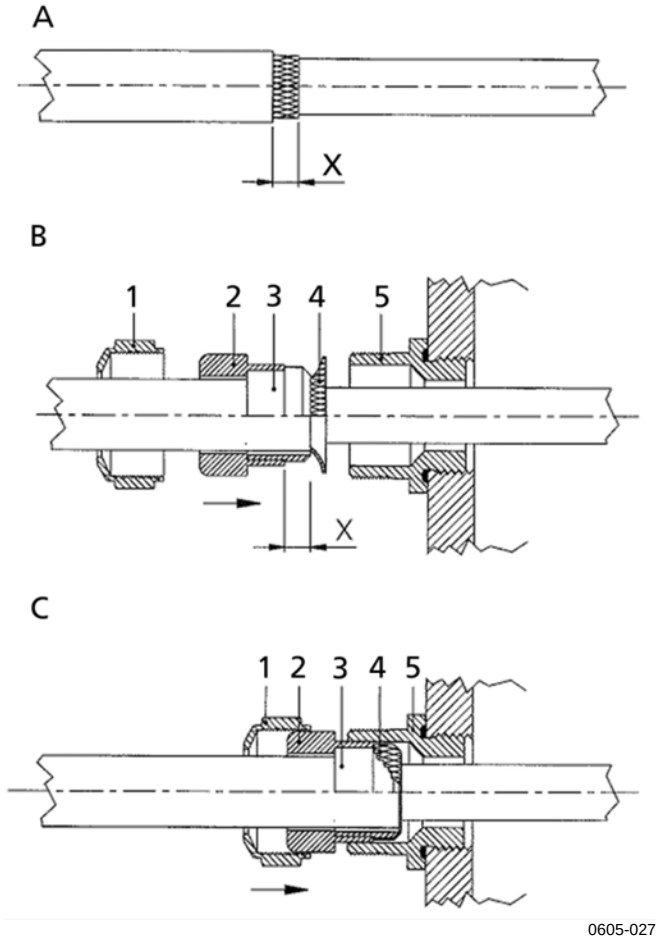


Figure 25 Grounding the Screen of Electrical Cable

Refer to Figure 25 above when performing the procedure below.

1. Cut back outer sheath to desired length.
2. Cut back screen braiding or screen foil to dimension X.
3. Push the domed cap nut (item 1) and the seal insert with contact socket of the gland (items 2 & 3) onto the cable as shown in the diagram.
4. Bend over the screen braiding or screen foil by about 90º (item 4).
5. Push the seal insert with the contact socket of the gland (items 2 & 3) up to the screen braiding or screen foil.
6. Mount the lower part (item 5) on the housing.
7. Push the seal with the contact socket of the gland (item 2 & 3) into the lower part (item 5).
8. Install the domed cap nut (item 1) onto the lower part (item 5).

Transmitter Housing Grounding

In case you need to ground the transmitter housing, the grounding connector is found inside the housing; see Figure 1 on page 22. Note anyhow that the probe is connected to the same potential as the housing. Make sure that different groundings are made to the same potential. Otherwise harmful ground currents may be generated.

If it is needed to have galvanic isolation of the power supply line from the output signals, DMT345/346 can be ordered with optional galvanic isolation module. This module prevents harmful grounding loops.

Signal and Power Supply Wiring

When connecting transmitter with 8-pin connector, see section 8-Pin Connector on page 62.

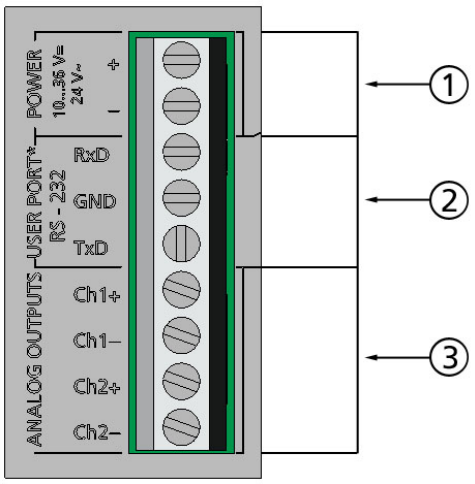


Figure 26 Screw Terminal Block on the Motherboard

The following numbers refer to Figure 26 above:

1 = Supply terminals **POWER 10 ... 35 VDC = 24 V~**
2 = User port (RS-232 terminals)
3 = Analog signal terminals

WARNING Make sure that you connect only de-energized wires.

1. Open the transmitter cover by taking out the four cover screws.
2. Insert the power supply wires and signal wires through the cable bushing in the bottom of the transmitter; see the grounding instructions in the previous sections.
3. Connect the analog output cables to terminals: **Ch1 +, Ch1-, Ch2+, Ch2-**. Connect the RS-232 user port cables to terminals RxD, GND and TxD. See section User Port Connection on page 77.
4. When wiring the optional modules, see the corresponding section for instructions:
   - Installation and Wiring of RS-422/485 Interface on page 54
   - Installation and Wiring of Alarm Relays on page 52
   - Third Analog Output on page 50
   - LAN Interface on page 58
   - WLAN Interface on page 59
5. Connect the power supply wires to the connectors: **POWER 10** ... **35 V = 24 V~ (+)** and **(–)** terminals. (If using AC voltage, **always** connect phase **(~)** to power supply **(+)** and **0** to power supply **(–)**). When wiring the power supply module, see section Power Supply Module on page 45.
6. Turn on the power. The indicator LED on the cover is lit continuously during normal operation.
7. Close the cover and replace the cover screws. The transmitter is ready for use.

Connections to a 24 VAC Power Supply

Separate floating supply for each transmitter is recommended (see the upper part of Figure 27 on page 44). If you have to connect several transmitters or other instruments to one AC supply, the phase (~) must always be connected to the (+) connector of each transmitter (see the lower part of Figure 27).

CAUTION **24 VAC POWER SUPPLY USE**

To prevent fire and/or damage, if either 24 VAC wire is grounded or connected to a "-", "0", or "GND" terminal of any other device, you must connect the same wire on the "-" terminal also on this instrument.

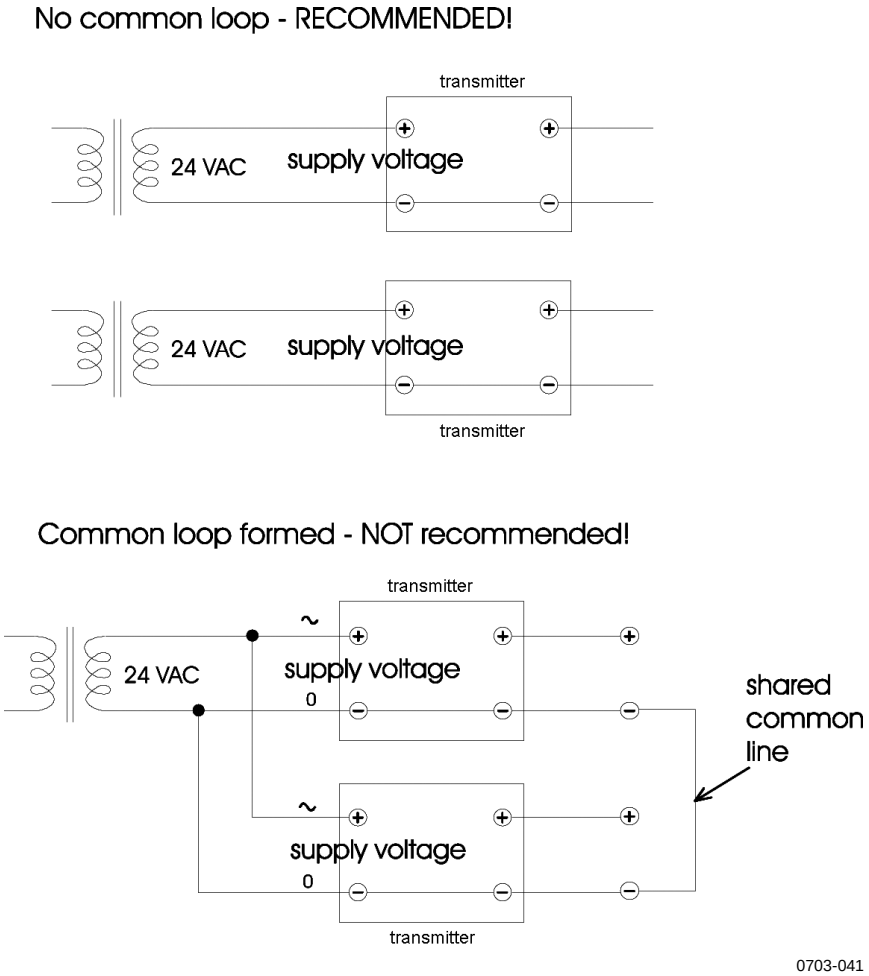


Figure 27 Connections to 24 VAC Power Supply

Optional Modules

Power Supply Module

The mains power connection may be connected to the power supply module only by an authorized electrician. A readily accessible disconnect device shall be incorporated in the fixed wiring.

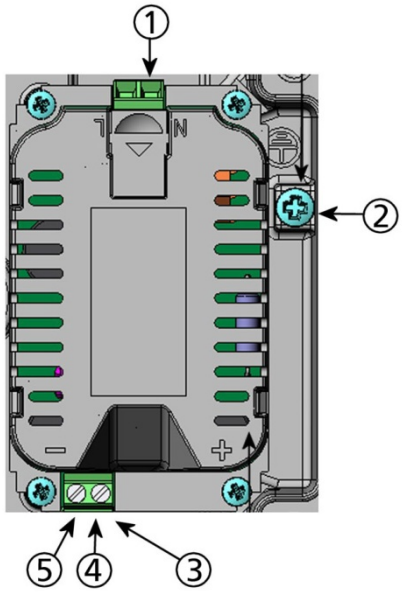


Figure 28 Power Supply Module

The following numbers refer to Figure 28 above:

1 = Connect AC mains voltage wires to these terminals
2 = Grounding terminal
3 = In case the module is not installed in the factory: Connect wires from these terminals to the POWER 10 ... 35V 24V terminals of the motherboard.
4 = +
5 = –

Installation

1. Disconnect the power.
2. Remove the protective plug from the cable gland and thread the wires. In case the power supply module is installed in the factory, continue with the step 5.
3. To attach the module, open the transmitter cover and fasten the power module to the bottom of the housing with four screws. See the position of the power module in Figure 2 on page 23.
4. Connect the wires from the terminals of the power supply module marked with + and – to the terminals **POWER 10 ... 35V = 24 V~** on the motherboard of the transmitter.
5. Connect the AC mains voltage wires to the power supply module terminals marked with **N** and **L**.
6. Attach the grounding wire to the grounding terminal on the right-hand side of the transmitter.
7. Connect the power. The LED on the cover of the transmitter is lit continuously during normal operation.

WARNING Do not detach the power supply module from the transmitter when the power is on.

WARNING Do not connect the mains power to power supply module when it is not installed in the transmitter.

WARNING Always connect protective ground terminal.

Warnings

Dieses Produkt entspricht der Niederspannungsrichtlinie (2006/95/EWG).

- Das Netzmodul darf nur von einem dazu befugten Elektriker angeschlossen werden.
- Trennen Sie das Netzmodul nicht vom Messwertgeber, wenn der Strom eingeschaltet ist.
- Verbinden Sie das Netzmodul nur mit der Spannungsquelle, wenn es im Messwertgeber DMT345/346 montiert ist.
- Das Erdungskabel muss zum Schutz immer angeschlossen sein.

Ce produit est conforme à la Directive relative à la Basse Tension (2006/95/EEC).

- Seul un électricien compétent est habilité à raccorder le module d'alimentation au secteur.
- Ne pas détacher le module d'alimentation du transmetteur lorsqu'il est en service.
- Ne pas raccorder le secteur au module d'alimentation lorsque celui-ci n'est pas installé dans le transmetteur DMT345/346.
- Toujours raccorder un bornier de protection à la terre.

Tämä tuote on pienjännitedirektiivin (2006/95/EEC) mukainen.

- Vaihtovirtaliitännän saa kytkeä tehonsyöttömoduuliin ainoastaan valtuutettu sähköasentaja
- Älä irrota tehonsyöttömoduulia lähettimestä, kun virta on kytkettynä.
- Älä kytke verkkovirtaa tehonsyöttömoduuliin, jos kyseistä moduulia ei ole asennettu DMT345/346 lähettimeen.
- Kytke aina maadoitusliittimet.

Denna produkt uppfyller kraven i direktivet om lågspänning (2006/95/EEC).

- Nätanslutningen (växelströmsanslutningen) får bara anslutas till strömförsörjningsmodulen av en behörig elektriker.
- Ta inte loss strömförsörjningsmodulen från mätaren när strömmen är på.
- Anslut inte strömförsörjningsmodulen till nätet när den inte är installerad i DMT345/346-mätaren
- Anslut alltid en skyddande jordningsplint.

Questo prodotto è conforme alla Direttiva sul basso voltaggio (2006/95/CEE).

- La conduttura elettrica può essere collegata al modulo di alimentazione elettrica soltanto da un elettricista autorizzato.
- Non staccare l'alimentazione elettrica dal trasmettitore quando è acceso.
- Non collegare la corrente elettrica al modulo di alimentazione elettrica se non è installato nel trasmettitore DMT345/346.
- Collegare sempre il morsetto protettivo a terra!

Dette produkt er i overensstemmelse med direktivet om lavspænding (2006/95/EØS).

- Netstrømskoblingen til må kun tilsluttes strømforsyningsmodulet af en autoriseret elinstallatør
- Strømforsyningsmodulet må ikke løsgøres fra senderen, mens spændingen er sluttet til.
- Slut ikke netspændingen til strømforsyningsmodulet, når det ikke er installeret i DMT345/346- senderen
- Forbind altid den beskyttende jordklemme!

Dit product voldoet aan de eisen van de richtlijn 2006/95/EEG (Laagspanningsrichtlijn).

- De stroom kan aan de stroomtoevoer module aangesloten worden alleen door een bevoegde monteur.
- Het is niet toegestaan de stroomtoevoer module van de transmitter los te koppelen wanneer de stroom aan is.
- Het is niet toegestaan de stroom aan de stroomtoevoer module aan te sluiten als deze niet in een DMT345/346-transmitter is gemonteerd.
- Altijd beschermend aardcontact aansluiten!

Este producto cumple con la directiva de bajo voltaje (2006/95/EEC).

- La conexión de la alimentación principal al módulo de alimentación sólo puede realizarla un electricista autorizado.
- No desenchufe el módulo de alimentación del transmisor cuando esté encendido.
- No conecte la alimentación principal al módulo de alimentación cuando no esté instalado en el transmisor DMT345/346.
- Conecte siempre el terminal de protección de conexión a tierra.

See toode vastab madalpinge direktiivile (2006/95/EEC).

- Voolukaabli võib vooluallika mooduli külge ühendada ainult volitatud elektrik.
- Ärge ühendage vooluallika moodulit saatja küljest lahti, kui vool on sisse lülitatud.
- Ärge ühendage voolukaablit vooluallika mooduli külge, kui seda pole DMT345/346-tüüpi saatjasse paigaldatud.
- Ühendage alati kaitsev maandusklemm!

Ez a termék megfelel a Kisfeszültségű villamos termékek irányelvnek (2006/95/EGK).

- A hálózati feszültséget csak feljogosított elektrotechnikus csatlakoztathatja a tápegységmodulra.
- A bekapcsolt távadóról ne csatolja le a tápegységmodult.
- Ne csatlakoztassa a hálózati feszültséget a tápegységmodulhoz, ha az nincs beépítve a DMT345/346 távadóba.
- Feltétlenül csatlakoztasson földelő védőkapcsot!

Šis produktas atitinka direktyvą dėl žemos įtampos prietaisų (2006/95/EB).

- Elektros tinklą su energijos tiekimo moduliu sujungti gali tik įgaliotas elektrikas.
- Niekada neišimkite energijos tiekimo modulio iš siųstuvo, kai maitinimas yra įjungtas.
- Jei energijos tiekimo modulis nėra įmontuotas DMT345/346 siųstuve, nejunkite jo į elektros tinklą.
- Visada prijunkite prie apsauginės įžeminimo jungties!

Šis produkts atbilst Zemsprieguma direktīvai (2006/95/EEC).

- Strāvas pieslēgumu var pieslēgt pie barošanas avota moduļa tikai autorizēts elektriķis.
- Neatvienot barošanas avota moduli no raidītāja, kad pieslēgta strāva.
- Nepievienot strāvu barošanas avota modulim, ja tas nav uzstādēts DMT345/346 raidītājā
- Vienmēr pievienot aizsargājošu iezemētu terminālu !

Ten produkt spełnia wymogi Dyrektywy niskonapięciowej (2006/95/EEC).

- Napięcie zasilające powinno zostać podłączone do modułu zasilacza tylko przez wykwalifikowanego elektryka.
- Nie wolno odłączać modułu zasilacza od nadajnika, kiedy zasilanie jest włączone.
- Nie wolno podłączać napięcia zasilającego do modułu zasilacza, kiedy nie jest on zamontowany w nadajniku DMT345/346.
- Zawsze należy podłączać zabezpieczający zacisk uziemiający!

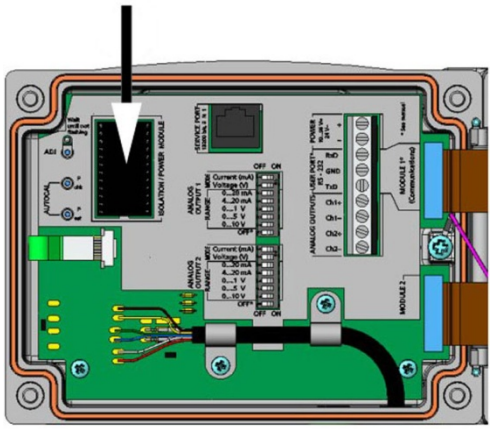
Tento výrobek vyhovuje Směrnici pro nízké napětí (2006/95/EEC).

- Připojení síťového napájení k napájecímu modulu smí provádět pouze oprávněný elektrikář.
- Neodpojujte napájecí modul od snímače při zapnutém napájení.
- Nepřipojujte síťové napájení k napájecímu modulu, pokud není instalován ve snímači DMT345/346.
    - Vždy zapojte ochrannou zemnící svorku!

Galvanic Isolation of Power Supply

If galvanic isolation of the power supply line from the output signals is needed, DMT345/346 can be ordered with optional galvanic isolation module. This module prevents harmful grounding loops.

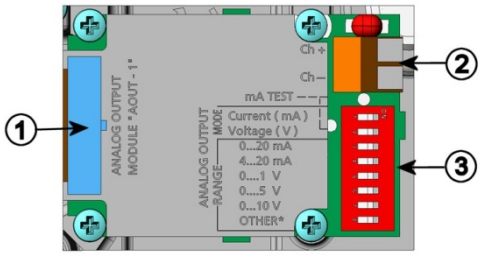
NOTE	Galvanic isolation module is not needed when using the AC power supply module. Note also that these two modules are physically incompatible to be installed at the same time. If both modules are installed, there is no room to close the transmitter cover completely.



0605-031

Figure 29 Galvanic Isolation Module

Third Analog Output



0503-030

Figure 30 Third Analog Output

The following numbers refer to Figure 30 above:

1 = Flat cable pins
2 = Screw terminals for signal line
3 = DIP switches to select the output mode and range

Installation and Wiring

1. Disconnect the power. In case the analog output module is installed in the factory, continue with the step 4.
2. Open the transmitter cover and and fasten the analog output module to the position for MODULE 2 with four screws. Refer to Figure 2 on page 23.
3. Connect the flat cable between the analog output module and the motherboard's connector for MODULE 2.
4. Take out the protective plug from the cable gland and thread the wires.
5. Connect the wires to the screw terminals marked with **Ch+** and **Ch-** .
6. Select the current/voltage output by setting ON either of the switches 1 or 2.
7. Select the range by setting ON one of the switches 3 ... 7.

NOTE Only one of the switches 1 … 2 can be ON at a time.

Only one of the switches 3 ... 7 can be ON at a time.

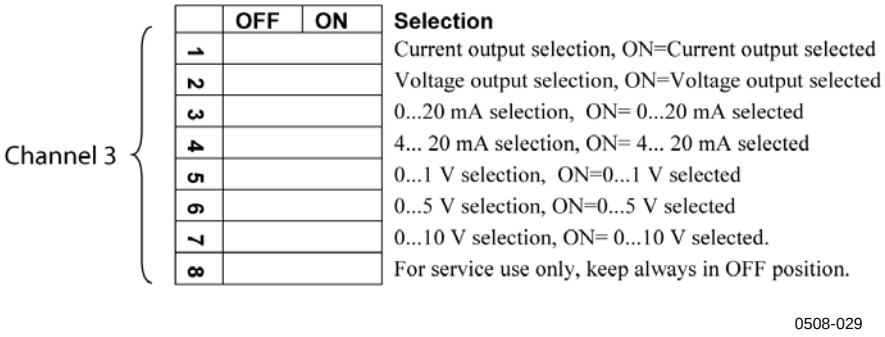

Channel 3
OFF
ON
Selection
1 Current output selection, ON=Current output selected
2 Voltage output selection, ON=Voltage output selected
3 0...20 mA selection, ON= 0...20 mA selected
4 4... 20 mA selection, ON= 4... 20 mA selected
5 0...1 V selection, ON=0...1 V selected
6 0...5 V selection, ON=0...5 V selected
7 0...10 V selection, ON= 0...10 V selected.
8 For service use only, keep always in OFF position.
0508-029

Figure 31 Third Analog Output Selection

8. Connect the power.
9. Select the quantity and scale the channel via the serial line or display/keypad, see section Analog Output Quantities on page 119. For testing the analog output, see Section Analog Output Tests on page 121. For fault indication setting, see section Analog Output Fault Indication Setting on page 122.

Alarm Relays

DMT345/346 can be equipped with one or two configurable relay modules. Each module contains two configurable relays. See the contact ratings in section Technical Specifications of Optional Modules on page 166.

Installation and Wiring

1. Disconnect the power. In case the relay-module is installed in the factory, continue with the step 5.
2. To attach the module, open the transmitter cover and fasten the relay module to the bottom of the housing with four screws. See the position in Figure 2 on page 23.
3. When the mains power is in use attach the grounding wire to the grounding terminal.
4. Connect the flat cable between the relay module and the motherboard's pins **MODULE 2** or **MODULE 1.**
5. Take out the protective plug from the cable gland and thread the relay wires.
6. Connect the wires to the screw terminals: **NO**, **C**, and **NC**.

CAUTION For installations in the USA: If your transmitter has both the relay module and a LAN or WLAN module, the maximum voltage you are allowed to connect to the relay module is 50 V.

Selecting Relay Activation State

The middlemost **C** terminal and either one of the terminals **NO**/**NC** shall be connected. The polarity can be freely selected.

NO	Normally open
C	Common relay
NC	Normally closed

Relay NOT activated: **C** and **NC** outputs are closed, **NO** is open
Relay IS activated: **C** and **NO** outputs are closed, **NC** is open.

Connect the power and close the cover. For instructions on how to operate the relay (for example, selecting quantity for the relay output and setting the relay setpoints), see section Operation of Relays on page 123.

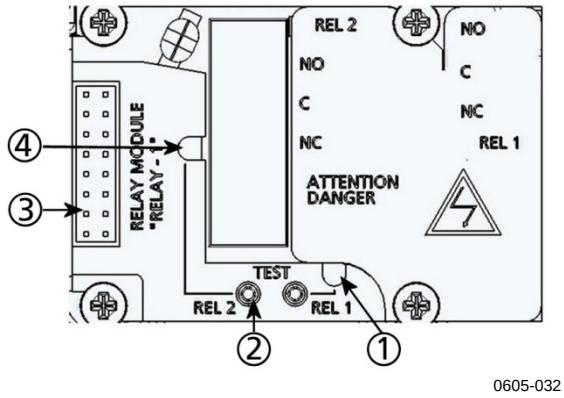


Figure 32 Relay Module

The following numbers refer to Figure 32 above:

1 = Indication LED for the relay 1 or 3
2 = Relay test buttons
3 = Flat cable pins
4 = Indication LED for relay 2 or 4

WARNING The relay module may contain dangerous voltages even if the transmitter power has been disconnected. Before working on the relay module you must switch off **both** the transmitter **and** the voltage connected to the relay terminals.

WARNING Do not connect the mains power to relay unit without grounding the transmitter.

RS-422/485 Interface

The RS-422/485 interface enables communication between an RS-485 network and the DMT345/346 transmitter. The RS-485 interface is isolated and offers a maximum communications rate of 115 200 bits/s. (For maximum bus length of 1 km, use bit rate 19200 b/s or less.)

When selecting an RS-232 to RS-485 converter for the network, avoid self-powered converters, as they do not necessarily support the needed power consumption.

NOTE RS-232 User Port on DMT345/346 main board cannot be used and connected when RS-485 module is connected. Service port operates normally.

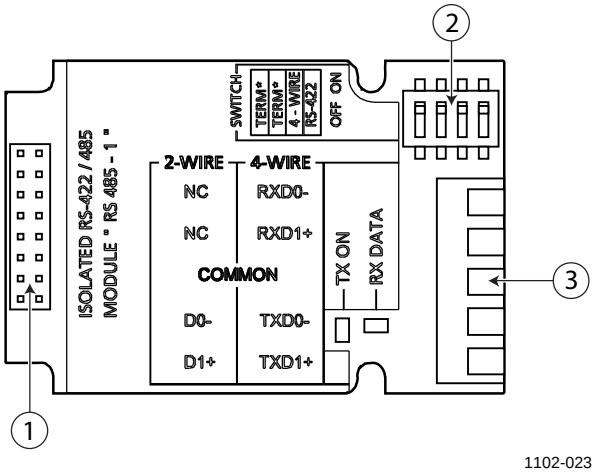


Figure 33 RS-422/485 Module

The following numbers refer to Figure 33 above:

1 = Flat cable pins
2 = Selection switches
3 = Screw terminals for wiring

NOTE	The data lines on earlier versions of the RS-422/485 module are marked A and B instead of D1+ and D0-. When the line is idle, D1+ has positive voltage compared to D0-. When connecting the module, be prepared to swap the D1+ and D0- wires if you have a communication problem.

Installation and Wiring

1. Disconnect the power. In case the RS-422/485-module is installed in the factory, continue with the item 4.
2. To attach the module, open the transmitter cover and fasten the RS-422/485 module to the bottom of the housing with four screws.
3. Connect the flat cable between the RS-422/485 module and the motherboard's pins **MODULE1 (Communications).**
4. Pull the network wirings through the cable gland.
5. Connect the twisted pair wires (1 or 2 pairs) to the screw terminals as presented in Table 6:

Table 6 Connecting Twisted Pair Wires to Screw Terminals

Screw Terminal	Data Line (2-wire RS-485)	Data Line (4-wire RS-485/422)
1	(not connected)	Rx D0-
2	(not connected)	Rx D1+
3	Common	Common
4	D0-	Tx D0-
5	D1+	Tx D1+

To avoid problems in the RS-422/485 network, the Common terminal should be wired to the corresponding terminals of the other devices.

6. If you use RS-422 or RS-485 to connect just one transmitter to a master computer, enable the internal termination of DMT345/346 by switching switches 1 and 2 ON. Make sure that the master's end of the line is also terminated (by using master's internal termination or with a separate terminator).

   If you are connecting many transmitters to the same RS-485 bus, make sure that switches 1 and 2 are OFF and terminate the bus with separate terminators at both ends. This allows removing any transmitter without blocking the bus operation.

NOTE If you use the internal termination of the transmitter at the end of the RS-485 bus (instead of using separate terminators) removing that transmitter will block the bus operation.

7. Use the bus type (4-wire/2-wire) to select the selection switch 3.

   In 4-wire mode RS-485 master sends data to the DMT345/346 through terminals Rx D1+ and Rx D0- and receives data from DMT345/364 through terminals Tx D1+ and Tx D0-.

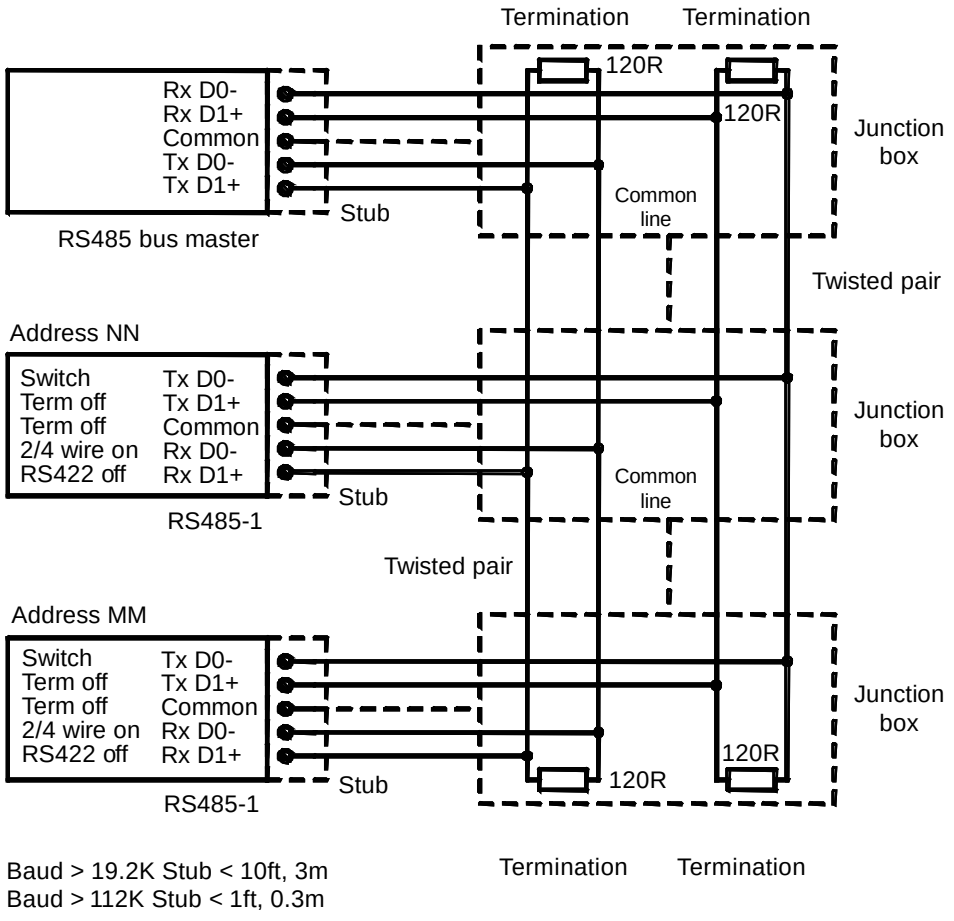


Figure 34 4-Wire RS-485 Bus Connections, Part A

Table 7 4-Wire (Switch 3: On)

RS-485 master	Data	DMT345/346
Tx D1+	→	Rx D1+
Tx D0-	→	Rx D0-
Rx D1+	←	Tx D1+
Rx D0-	←	Tx D0-

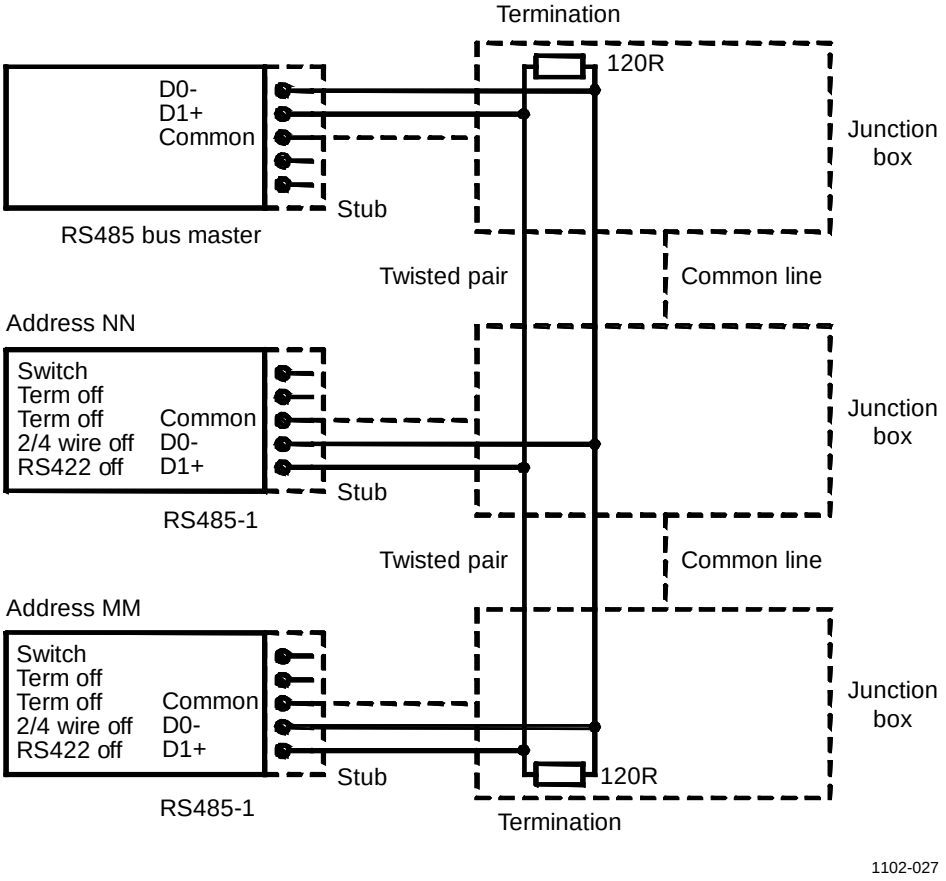


Figure 35 2-Wire RS-485 Bus

Table 8 2-Wire (Switch 3: Off)

RS-485 master	Data	DMT345/346
D1+	↔	D1+
D0-	↔	D0-

8. When operating in communication mode RS-422, set both switches 3 and 4 to ON position (4-wire wiring is required for RS-422 mode).
9. Connect the power and close the cover.

LAN Interface

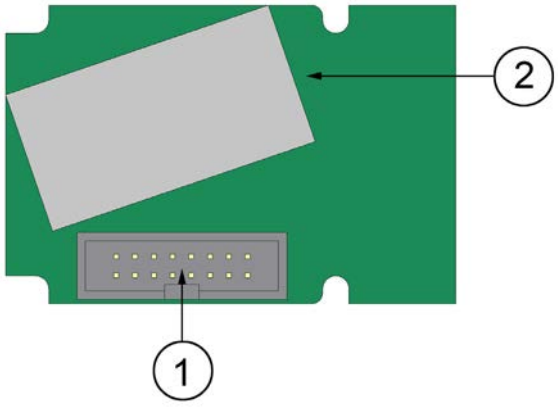
The optional LAN interface enables an Ethernet connection to the transmitter. The user can establish a virtual terminal session using a Telnet client program such as PuTTY or by using Modbus TCP protocol.. When the LAN interface is in use, serial communication using the RS-232 User Port is disabled.

The LAN interface module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Once installed, the module is automatically used by the transmitter. The physical connection to the network is made to the RJ45 connector on the LAN interface module, using a standard twisted pair Ethernet cable (10/100Base-T). Transmitters with the optional LAN interface are delivered pre-installed with a suitable cable and cable gland.

The LAN interface can use both static and dynamic network settings. If the interface is configured to use dynamic settings, the network where the LAN interface is connected must have a DHCP server that provides the settings.

The network configuration can be done using the optional display and keypad, or by using the service port. For instructions, see section LAN Communication on page 80. The LAN interface also provides a web configuration interface, which you can access by entering the IP address of the LAN interface in the address field of a web browser. See section Web Configuration for LAN and WLAN on page 86.

CAUTION The LAN interface is designed to be used in trusted network environments (trusted corporate LAN or VPN-based connection over internet). Avoid connecting the transmitter directly to a public network because the device can be attacked by a malicious user through the network.



1 = Flat cable connector
2 = RJ45 connector with indicator LEDs for link and activity

Figure 36 LAN Interface Module

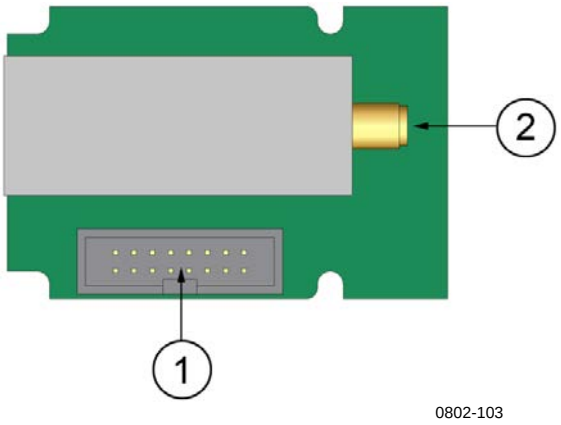
WLAN Interface

The optional WLAN interface enables a wireless Ethernet connection (IEEE 802.11b) to the transmitter. The user can establish a virtual terminal session using a Telnet client program such as PuTTY or by using Modbus TCP protocol. When the WLAN interface is in use, serial communication using the RS-232 User Port is disabled.

The interface supports Wired Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA, WPA2). For WEP, 64 and 128 bit encryption is supported, with open system or shared key authentication. WPA is used in the Pre-Shared Key (PSK) mode, with either TKIP or CCMP (also known as AES) encryption.

Similarly to the LAN interface, the WLAN interface can use both static and dynamic network settings. If the interface is configured to use dynamic settings, the network where the WLAN interface is connected must have a DHCP server that provides the settings.

The WLAN interface also provides a web configuration interface, which you can access by entering the IP address of the WLAN interface in the address field of a web browser. See section Web Configuration for LAN and WLAN on page 86.



1 = Flat cable connector
2 = Connector for antenna cable (connected to transmitter cover)

Figure 37 WLAN Interface Module

CAUTION	The WLAN interface is designed to be used in trusted network environments (trusted corporate LAN or VPN-based connection over internet). Avoid connecting the transmitter directly to a public network because the device can be attacked by a malicious user through the network.

NOTE The default country setting for the WLAN interface is United States, which limits the operation to WLAN channels 1 ... 11. To enable additional channels (12 ... 14), you can change the country setting using the web configuration interface.

Attaching the WLAN Antenna

The WLAN interface module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Before taking the transmitter into use, you must attach the antenna of the WLAN interface into the RP-SMA connector on the transmitter cover. The location of the antenna is shown in Figure 81 on page 170.

Data Logger Module

The optional data logger module extends the data storage for the measurement data. When the data logger is present, this storage is automatically used by the transmitter. The stored data can be browsed using the optional display module, and accessed through the serial connections. See sections Graphic History on page 65 and Data Recording on page 114.

The data logger module contains non-volatile flash memory providing 4 years and 5 months of storage for 4 parameters at a 10-second sampling interval. When the memory is full, the data recording will not stop. Instead, the oldest data is overwritten. For each parameter and observation period, the module stores the minimum and maximum values during the interval, as well a data trend value that is averaged from samples taken during the interval (see Table 9 below).

Table 9 Observation Periods and Resolution

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
3 hours	90 seconds
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days
4 years	12 days

The quantities that are logged are the same that have been selected for measurement using the display/keypad or the serial line. When taking the transmitter into use, verify that the desired quantities are selected. If you change the quantities later, the transmitter will start logging the new quantities, and stop logging the quantities that are no longer selected. Changing the quantities does not delete any measurement data that is already in memory. However, the data of any removed quantity cannot be accessed unless the quantity is re-activated first.

The data logger module has a real time clock with a battery back-up. The clock has been set to the Coordinated Universal Time (UTC) at the factory, and its time cannot be set by the user. The data that is stored in the logger's memory is timestamped using the logger's clock.

When date and time are set on the transmitter, they are stored to the transmitter's memory as an offset from the time on the logger's clock. When browsing the stored data, the time offset is applied to the timestamps shown in the graphical history, and data outputted from the serial port. The timestamps in the data logger's memory remain as they were originally stored.

You can compensate for the clock drift (less than ±2 min/year) by setting the time on the transmitter. This updates the time offset used on the display and the serial port. You can set the time by using the keypad/display or the serial commands.

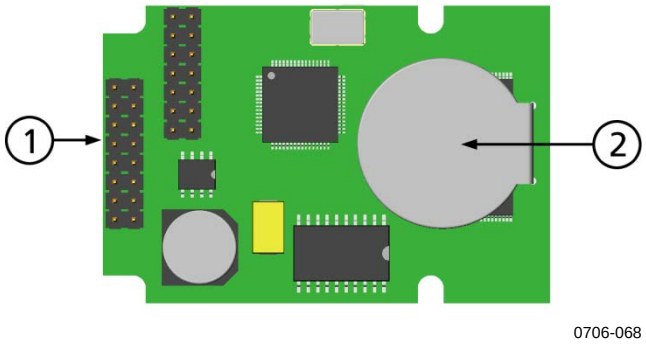


Figure 38 Data Logger Module

After a reset or a power up, it will usually take at least 10 seconds before the data logger module is initialized. The instrument will not start up before the data logger module is ready.

The indicator LED on the module will blink green during normal operation. If the LED is lit in red color, there is a problem with the module. The transmitter will also indicate the problem by activating the "Internal error on add-on module" error. If the module is not operating correctly, the transmitter must be sent to Vaisala for maintenance.

The data logger module must be installed at the factory (when ordering the transmitter), or by a Vaisala Service Center. Once installed, the module is automatically used by the transmitter. When the module requires a new battery, the transmitter must be sent to Vaisala for maintenance.

8-Pin Connector

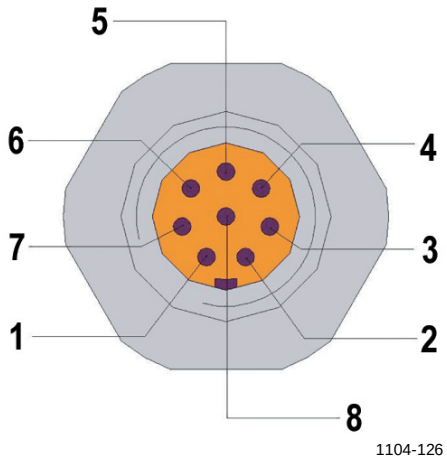


Figure 39 Pinout of the Optional 8-Pin Connector

Table 10 Wiring of the Optional 8-Pin Connector

Pin	Wire	Serial Signal		Analog Signal
		RS-232 (EIA-232)	RS-485 (EIA-485)	
1	White	Data out TX	D1+	-
2	Brown	(Serial GND)	(Serial GND)	Signal GND (for both channels)
3	Green	-	-	Ch 2 +
4	Yellow	-	-	Ch 1 +
5	Grey	Supply –	Supply –	Supply –
6	Pink	Supply +	Supply +	Supply +
7	Blue	Data in RX	D0-	-
8	Shield/Red	Cable shield	Cable shield	Cable shield

CHAPTER 4

OPERATION

This chapter contains information that is needed to operate this product.

Getting Started

Within a few seconds after power-up the LED on the cover of the transmitter is lit continuously indicating normal operation. When the transmitter is turned on the first time, the language selection window opens: Select the language with ▲▼ arrow buttons and press the **SELECT** button (the left-hand [−] button).

Pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the ambient pressure is taken into consideration. See section Pressure Compensation Setting on page 100 for instructions on how to set the pressure.

Start-up time for DMT345/346 transmitter is in total about 6 minutes. The outputs (serial and analog) are activated 3 seconds after powering up the transmitter. If the data logger module is installed, the it may take up to 18 seconds for the outputs to be activated.

In addition, 10 seconds after the measurement the outputs will freeze for about 6 minutes due to the sensor self diagnostics procedure (Sensor Purge and AutoCal). The frozen output value will be the value the transmitter reached during the 10 seconds of measurement. After the self diagnostics procedure the outputs are operational again.

Display/Keypad

Basic Display

Display shows you the measurement values of the selected quantities in the selected units. You can select 1 ... 4 quantities for the numerical basic display (see section Changing Quantities and Units on page 97).

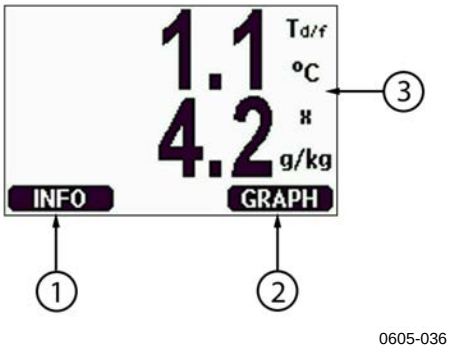


Figure 40 Basic Display

The numbers refer to Figure 40 above:

1 = **INFO** shortcut button
2 = **GRAPH** shortcut button changes the display into a curve mode
3 = Selected quantities

Press the **INFO** button (in the basic display) to see the device information views, see section Device Information on page 106.

NOTE	From any view, even in the absence of an **EXIT** button, a four-second press on the right-hand function button takes you directly to the basic display.

Graphic History

The graphical display shows the data trend or min/max graph of the selected quantities, one at a time. The graph is updated automatically while measuring.

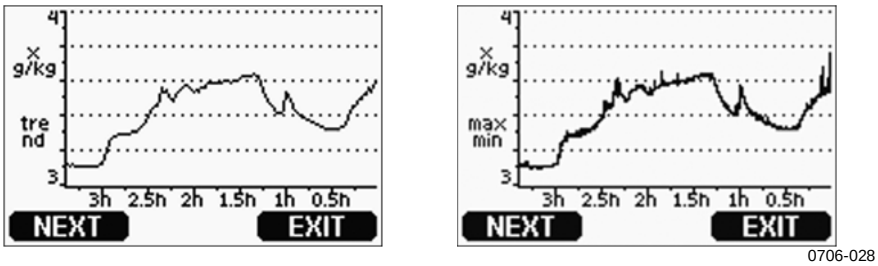


Figure 41 Graphical Display

Trend graph: Shows you a curve of average values. Each value is a calculated average over a period. See Table 11 below.

Max/min graph: Shows you the minimum and maximum values in a form of curve. Each point shows the absolute minimum and maximum observed during the time period represented by the data point. See Table 11 below.

Table 11 Periods for Trend and Max/Min Calculations

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
3 hours	1.5 minutes
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days
4 year*	12 days

* Shows the maximum logging period of the data logger module (available when data logger module is installed)

Use the following functions in the graphical display:

- Press the **NEXT** button to change between the trend graph and max/min graph for the quantities selected for display.
- Press the **EXIT** button to return to the basic display.
- Press the ▼▲ arrow buttons to zoom in and out in the graph window.
- Press the ◄► arrow buttons move the cursor (vertical bar) along the time axis. The cursor mode allows you to observe individual measuring points. The numerical value at the cursor position is shown at the left upper corner. The right upper corner shows the time from the present to the chosen moment (without the logger module), or the date and time at the cursor position (when the logger module is installed).

- If the optional data logger module is installed, you can scroll the cursor off the screen to move to a new point on the time axis. The new date will be displayed, and the cursor will be centered at the date where the cursor scrolled off the screen.

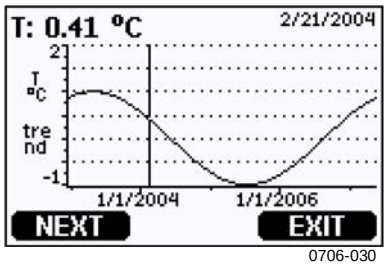


Figure 42 Graphical Display with Data Logger

If the data logger module is installed, you can move quickly on the time axis: zoom out, move the cursor, and zoom back in.

The time that is shown below the graph is adjusted with the current time offset of the transmitter. If you change the transmitter's date and time setting, the displayed timestamps in the history graph change accordingly. For an explanation of the effect of changing the date and time manually, see section Data Logger Module on page 60.

Table 12 Graph Information Messages

Failure Message	Interpretation
Power outage	Power failure (marked also with dashed vertical line)
No data	Quantity has not been selected for the display
System error	General device or power supply problem
T meas. error	Temperature measurement/sensor failure
RH meas. error	Humidity measurement/sensor failure
Adj. mode active	Adjustment mode active (data recorded in the adjustment mode is not displayed)
Autocal	AutoCal performed (only shown in 3 h graphs)

A question mark after time tells you that at least one power failure (dashed vertical line) has occurred after the chosen moment. In this case, the actual time difference between the present and the cursor position is not exactly known. If the data logger module is installed, the time is known and the question marks are not present.

Menus and Navigation

You can change settings and select functions in the menus.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons in the basic (numeric) display mode.
2. Move in the menus by using the ▲▼ arrow buttons.
3. Open a submenu with the ► button.
4. Press ◄ to return to the previous level.
5. Function button **EXIT** returns you back to the basic display.

Adjustment menu is displayed only when **ADJ** button (on the motherboard inside the transmitter) is pressed.

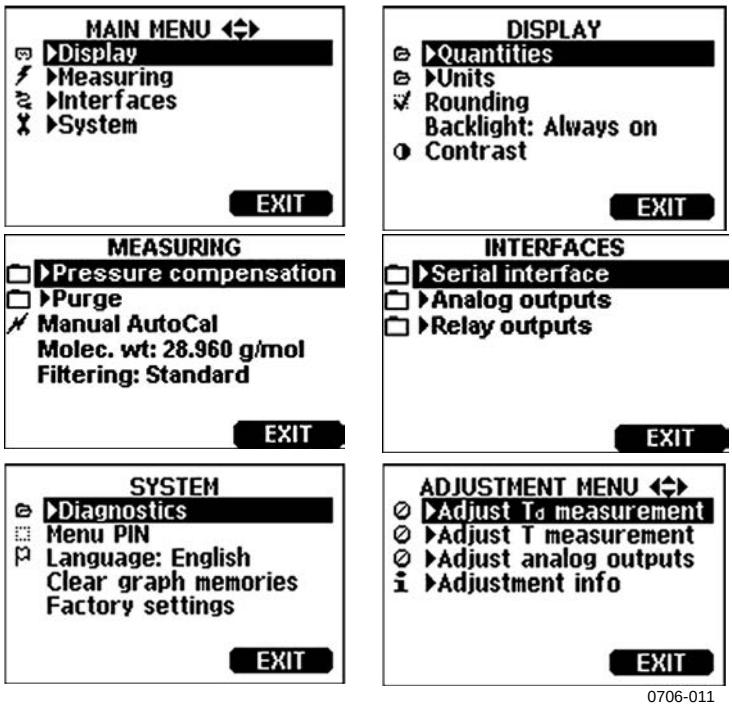


Figure 43 Main Views

Some menu items, such as **Relay outputs** in the **Interfaces** menu, are only shown if supported by the transmitter and the installed options.

Changing the Language

1. Go back to the basic display by keeping the right-hand button pressed for four seconds.
2. Open the **Main Menu** by pressing any of the ▼▲◄► buttons.
3. Scroll to the **System** menu option, and press the ► button. The menu option is indicated with the wrench symbol.
4. Scroll to the **Language** menu option, and press the left-hand button. The menu option is indicated with the flag symbol.
5. Select the language with the ▼▲ buttons, and confirm the selection by pressing the left-hand button.
6. Press the right-hand button to exit to the basic display.

Rounding Setting

Round off one decimal by using the Rounding function . The default setting is rounding on. Rounding has no effect on quantities without decimals.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select ►**Display** and confirm by pressing the ► arrow button.
3. Select **Rounding** and press **ON/OFF** button.
4. Press **EXIT** to return to the basic display.

Display Backlight Setting

As a default the display backlight is always on. In the automatic mode the backlight stays on for 30 seconds from the last press of the button. When pressing any button, the light turns on again.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select ►**Display**, press the ► arrow button.
3. Select **Backlight**, press the **CHANGE** button.
4. Select **On/Off/ Automatic**, press the **SELECT** button.
5. Press **EXIT** to return to the basic display.

Display Contrast Setting

Display contrast is automatically adjusted based on the ambient temperature. However, depending on the installation location and viewing direction, it may be necessary to fine-tune the contrast manually.

Using Display/Keypad

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select ►**Display**, press the ►arrow button.
3. Select **Contrast**, press the **ADJUST** button.
4. Adjust the contrast by pressing the ◄► arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Using Serial Line

Use the serial line command **CON** to view or set the display contrast.

CON [xxx]<cr>

where

xxx = Contrast value for display. Recommended range -9 ... 9, default 0. Negative values make screen lighter, positive values make it darker.

Example (view current contrast setting):

```
>con
Contrast       : 0
>
```

Example (set contrast to 5):

```
>con 5
Contrast       : 5
>
```

Keypad Lock (Keyguard)

This function locks the keypad and prevents unintentional key presses.

1. Keep pressing the left-hand ⊟ button for 4 seconds to lock the keypad (at any display).
2. To unlock the keypad, press the **OPEN** button for 4 seconds.

Menu PIN Lock

You can prevent unauthorized changes of the device settings by activating the menu PIN lock. When this function is activated, the basic display, graphical view, and device information displays are available but access to the menus is locked. The key symbol indicates the activation of this feature.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select ►**System**, press the ►arrow button.
3. Select **Menu PIN**, press the **ON** button.
4. Enter a PIN code by using the ▲▼ arrow buttons. Press **OK** to confirm the setting. Now the PIN lock is on and a key symbol is shown in a display.
5. Press **EXIT** to return to the basic display. Returning to the menu is possible only by entering the correct PIN code.

When you want to turn off the PIN lock, go to the menu by giving the PIN code and select ►**System, Menu PIN,** press **OFF** button.

In case you have forgotten the PIN code, open the transmitter cover and press the **ADJ** button once. Wait for a few seconds and the adjustment menu opens. Select **Clear menu PIN**, press **CLEAR.**

NOTE You can also disable the keypad completely with serial command **LOCK**. See section Locking Menu/Keypad Using Serial Line on page 109.

Factory Settings

Use the display/keypad to restore the factory settings. This operation does not affect the adjustments. Only settings available in the menus are restored.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **System** by pressing the ► arrow button.
3. Select **Factory settings** and press the **REVERT** button to confirm your selection. Press the **YES** button to reset all settings to the factory defaults.

See section General Settings on page 97 for a description of the other menu options.

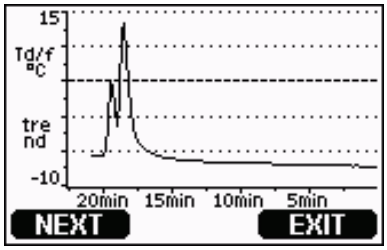
Display Alarms

The Display Alarm feature provides two independently configurable alarms for transmitters with the display/keypad option. Each alarm tracks a selected quantity, with freely configurable limit values. Each alarm also has a configurable hysteresis value to prevent unnecessary triggering when the measurement fluctuates around an alarm limit. The alarms can be configured for any quantity supported by the transmitter. The configuration of the Display Alarms can only be done using the display/keypad option.

You can have the alarm activate inside or outside the specified range by setting the limits correctly:

- To have the alarm activate when the measured quantity is outside the specified range, set the **Act. above** limit higher than the **Act. below** limit.
- To have the alarm activate when the measured quantity is inside the range, set the **Act. above** limit lower than the **Act. below** limit.

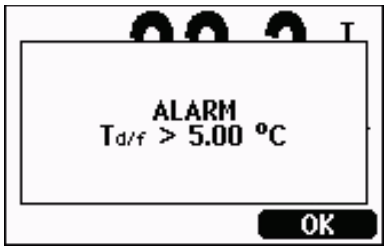
The alarm limits are shown on the graph display as thicker dotted lines. When a display alarm is activated, the automatic scaling of the graph display always keeps the limits in view.



1103-062

Figure 44 Alarm Limit Shown on Graph Screen

When an alarm is activated, an alarm note is displayed on the display, and the lights of the display will blink. If the data logger module is installed, the alarm note includes the time and date of the alarm.



1103-063

Figure 45 Display Alarm Active

Multiple alarms can be active at the same time; the alarm that was triggered first will be shown on the display. The next active alarm is revealed when the currently shown alarm is acknowledged by pressing the **OK** button.

Activated alarms are only shown on the screen; there are no alarm messages output to the serial line. After an alarm has been acknowledged, you must refer to the data graphs to see when the measured quantities have exceeded the limits. You may use the optional relay outputs as alarm outputs by configuring them separately; see section Setting Relay Outputs on page 127.

Configuring a Display Alarm

1. Enter the **Main Menu** by pressing an arrow key on the keypad.
2. Use the arrow keys to select **Display**, followed by **Alarms,** to open the **Display Alarms** menu. The **Display Alarms** menu shows the currently enabled and disabled alarms.

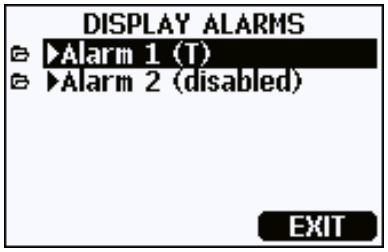
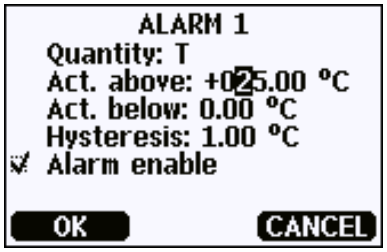


Figure 46 Display Alarms

3. Use the arrow keys to select an alarm to configure. The alarm editing page opens.

NOTE	Changes you do on the alarm editing page will take effect immediately, and may cause an alarm to appear on the screen.

4. To select a quantity for the alarm, press the **Change** button and select the quantity from the list.
5. To modify or remove the alarm limit values, move the selection over the **Act. above** or **Act. below** field and press the **Set** button. You will be prompted to **Modify** or **Remove** the value.



0802-070

Figure 47 Modifying an Alarm Limit

When modifying the value, use the arrow up and down buttons to change the value under the cursor. Left and right arrow buttons move the cursor. Select the **OK** button to accept the modified value, or **Cancel** to undo the modification.

6. Set a suitable **Hysteresis** value to prevent the alarm from being triggered unnecessarily by small measurement changes that pass the alarm limit repeatedly.
7. Set or clear the **Alarm enable** checkbox to enable or disable the alarm.
8. Press the **Exit** button to leave the alarm configuration screen and return to the basic view.

Using Serial Line

Use the serial line command **ALSEL** to view or set the display alarms.

ALSEL [quantity1 quantity2]<cr>

where

quantity1 = Quantity for display alarm 1. You can set any quantity available on your transmitter; see page 20. In addition to quantities, you can also select the following:

FAULT – Alarm for device errors
ONLINE – Alarm for sensor operations that freeze the measurement output (for example, sensor purge).

quantity2 = Quantity for display alarm 2. Options are the same as for quantity1.

Example (view current display alarm settings):

```
>alsel ?
Al1 Tdf   above: 0.00 'C
Al1 Tdf   below: -
Al1 Tdf   hyst : 1.00 'C
Al1 Tdf   enabl: ON
Al2 T     above: 40.00 'C
Al2 T     below: -
Al2 T     hyst : 1.00 'C
Al2 T     enabl: ON
>
```

Table 13 ALSEL Parameters

Name	Description
above	If specified, the alarm goes off when the quantity value rises above the exact value of this setpoint. However, if above < below, the alarm goes off at (above + hyst) and (below – hyst) instead. Cannot be set for fault and online alarms.
below	If specified, the alarm goes off when the quantity value decreases below the exact value of this setpoint. However, if above < below, the alarm goes off at (above + hyst) and (below – hyst) instead. Cannot be set for fault and online alarms.
hyst	Distance from setpoint amount of extra retractment needed in order to regenerate alarm on the next crossing of the setpoint. Cannot be set for fault and online alarms.
enabl	Enable (ON) or disable (OFF) the display alarm.

Example (set H2O and T as display alarm quantities and configure the alarms as prompted):

```
>alsel h2o t
Al1 H2O   above: 0.00 ppmV ? 6000
Al1 H2O   below: - ?
Al1 H2O   hyst : 1.00 ppmV ? 500
Al1 H2O   enabl: ON ?
Al2 T     above: 40.00 'C ? 30
Al2 T     below: - ?
Al2 T     hyst : 1.00 'C ?
Al2 T     enabl: ON ?
>
```

MI70 Link Program for Data Handling

MI70 Link is a support program that enables you to handle the measurement data of your Vaisala transmitter using a Windows PC. Using the MI70 Link you can, for example:

- Monitor the transmitter's measurement readings directly using the real-time window function.
- Transfer recorded data from the main transmitter memory in numeric or graphical format, for further use in a spreadsheet program (such as Microsoft Excel) or virtually any other application. Note that the maximum amount of data points that can be downloaded in one transfer is 65000.

To use the MI70 Link program, you must connect your Windows PC to the service port of the transmitter with a serial or USB cable. The MI70 Link program, and the optional connection cables, are available from Vaisala. See section Spare Parts and Accessories on page 168.

Follow the steps below to connect your transmitter and start using the MI70 Link:

1. Connect your PC to the service port of the transmitter. Refer to section Service Port Connection on page 78.
2. Check that the transmitter is powered.
3. Start the MI70 Link program.
4. Start using the program. There is usually no need to select a COM port manually, the MI70 Link software can detect it automatically.

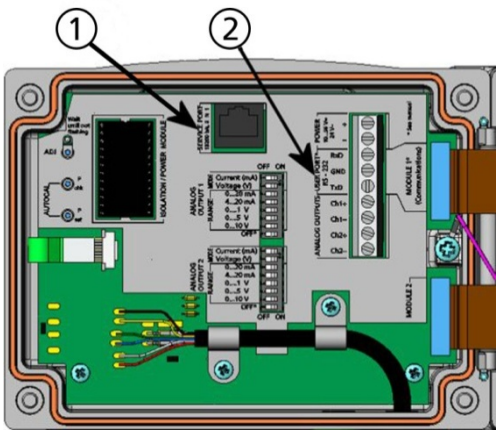
NOTE	For instructions on using the MI70 Link, see the program's online help.

Serial Line Communication

Connect the serial interface by using either the user port or the service port.

For permanent interfacing to host system, use the user port. You can change the serial settings and operate in RUN, STOP, POLL, and MODBUS modes.

For temporary connections use the service port. Service port is always available with fixed serial settings.



0605-039

Figure 48 Service Port Connector and User Port Terminal on the Motherboard

The following numbers refer to Figure 48 above:

1 = Service port connector
2 = User Port Terminals

User Port Connection

Use suitable serial cable between the user port RxD, GND and TxD screw terminals and the PC serial port.

Table 14 Default Serial Communication Settings for User Port

Parameter	Value
Bauds	4800
Parity	Even
Data bits	7
Stop bits	1
Flow control	None

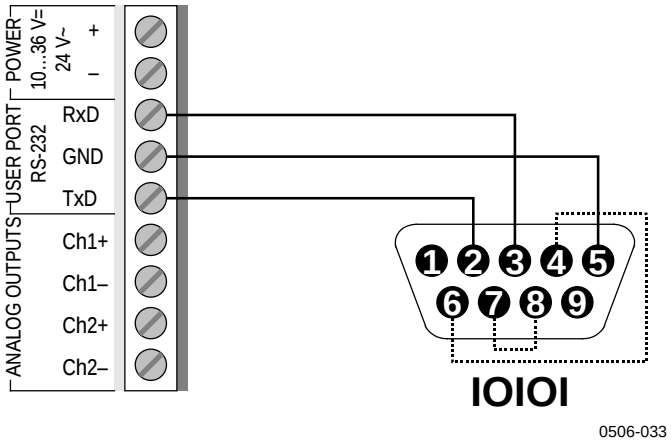


Figure 49 Connection Example between PC Serial Port and User Port

Connections to pins 4,6,7 and 8 are required only if your software requires hardware handshaking.

NOTE User port cannot be used when the RS-485 module is connected.

User Port Operating Modes

When the transmitter is powered up, it will behave according to its configured operating mode:

- In STOP mode, the transmitter outputs the software version and the command prompt (if echo is on).
- In RUN mode a measurement output starts immediately.
- In POLL or MODBUS mode, the transmitter does not output anything after power-up.

For a description of the modes, see section SMODE on page 112.

NOTE RS-232 User Port cannot be used when a communication module (LAN, WLAN, or RS-422/485 interface) has been installed.

Service Port Connection

Connection Cables

To connect to the service port, you need a suitable cable with an RJ45 connector. Depending on the connections of your PC, you can either use the Serial Connection Cable (optional accessory 19446ZZ) or the USB-RJ45 Serial Connection Cable (optional accessory 219685). The USB cable enables you to connect the transmitter to a PC via a standard type A USB port. Note that the USB cable does not enable high speed data transfer, since the bit rate is limited by the serial interface of the service port.

Installing the Driver for the USB Cable

Before taking the USB cable into use, you must install the provided USB driver on your PC. When installing the driver, you must acknowledge any security prompts that may appear.

1. Check that the USB cable is not connected. Disconnect the cable if you have already connected it.
2. Insert the media that came with the cable, or download the latest driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults.
4. After the driver has been installed, connect the USB service cable to a USB port on your PC. Windows will detect the new device, and use the driver automatically.
5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the **Vaisala USB Instrument Finder** program that has been installed in the Windows Start menu.

Windows will recognize each individual cable as a different device, and reserve a new COM port. Remember to use the correct port in the settings of your terminal program.

Using the Service Port

1. Open the screws on the transmitter cover, and open the cover.
2. Connect the desired cable (serial interface cable or USB cable) to your PC and the service port connector on the transmitter. For location of the service port, refer to Figure 48 on page 76.
3. Open a terminal program and set the communication settings as follows:

Table 15 Communication Settings for the Service Port

Parameter	Value
Bauds	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

For a detailed explanation of using a terminal program, see section Terminal Program Settings on page 87.

4. Power-up the transmitter.

LAN Communication

To enable LAN communication, a LAN or WLAN interface must be physically connected to the network, and the networking settings must be suitable for your network. For a description of interfaces, see sections LAN Interface on page 58 and WLAN Interface on page 59.

The LAN and WLAN interfaces both operate by accessing the serial interface (User Port) of the transmitter. All commands and protocols that are available using the serial interface are available through the LAN and WLAN interfaces; refer to section List of Serial Commands on page 90. For instructions on how to connect using a terminal program, see section Terminal Program Settings on page 87.

IP Configuration

The IP settings of the LAN and WLAN interfaces are described in Table 16. The current settings can be viewed on the serial line or using the device information display; see section Device Information on page 106.

Table 16 IP Settings for the LAN and WLAN Interfaces

Parameter	Description
Automatic configuration (DHCP)	If enabled, the transmitter will retrieve its network settings (including the IP Address) from a server in the network. If disabled, static network settings are used instead.
Web configuration	If enabled, the settings of the interface can be changed using a web browser. The configuration page can be accessed by browsing to the IP address of the transmitter.
IP Address	The four part network ID of the transmitter. Must be set manually if automatic configuration is not used. Example value: **192.168.0.222**
Netmask	Used together with the IP address to determine which network the transmitter is a part of. Must be set manually if automatic configuration is not used. A common netmask is **255.255.255.0**
Gateway	IP address of the server that enables the transmitter to access other networks. Must be set manually if automatic configuration is not used. Example value: **192.168.0.1**
MAC	The MAC address is the unique hardware address of the LAN or WLAN interface. Cannot be changed.

Using Display/Keypad

You can configure the IP settings of the LAN and WLAN interfaces using the display/keypad as follows:

1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Interfaces**.
3. Press ► arrow button to select **Network settings**. There will be a delay as the transmitter refreshes the network information.
4. You are now in the **Network Interface** menu. Selecting the **IP configuration** option opens the IP configuration menu.

1102-015

Figure 50 Network Interface Menu

The **Network Interface** menu also allows you to configure the **Communication Protocol**, enable or disable the **Web configuration** option, or **Disconnect all** users that are currently accessing the LAN or WLAN interface.

5. In the IP configuration menu, select **Automatic configuration (DHCP)**, or enter the **IP address**, **Netmask** and **Gateway** manually. If automatic configuration is enabled, manual configuration cannot be done.

0709-004

Figure 51 IP Configuration Menu

To enter a value manually, use the ▲▼ arrow buttons to select the parameter to change, and press **Change**. A cursor will appear in the first digit. Move the cursor using the ◄► arrow buttons, and change the value under the cursor using the ▲▼ arrow buttons. Confirm the selection by pressing **OK**.

6. After configuring the desired parameters, press **EXIT** to apply the changes and return to the basic display.

Using Serial Line

Use the serial line command **NET** to view or set the network settings for the LAN and WLAN interfaces. You can also refresh the network information or disconnect all active connections.

NET [*REFRESH*] [*DISCONNECT*] [*DHCP WEB*] [*DHCP IP SUBNET GATEWAY WEB*]<cr>

where

REFRESH	=	Updates the network information and displays it.
DISCONNECT	=	Disconnects all current sessions.
DHCP	=	ON or OFF. Enables or disables the automatic IP configuration.
WEB	=	ON or OFF. Enables or disables the Web Configuration page.
IP	=	The four part network ID of the transmitter. Must be set manually if automatic configuration is not used.
SUBNET	=	Used together with the IP address to determine which network the transmitter is a part of. Must be set manually if automatic configuration is not used.
GATEWAY	=	IP address of the server that enables the transmitter to access other networks. Must be set manually if automatic configuration is not used.

Examples:

```
>net refresh
OK
DHCP           : OFF
IP address     : 192.168.0.101
Subnet mask    : 255.255.255.0
Default gateway: 192.168.0.1
Web config.    : OFF
MAC address    : 00:40:9d:2c:d2:05
Status         : Not connected
>

>net on off
DHCP           : ON
IP address     : 192.168.0.104
Subnet mask    : 255.255.255.0
Default gateway: 192.168.0.1
Web config.    : OFF
MAC address    : 00:40:9d:2c:d2:05
Status         : Connected
OK
>
```

```
>net off 192.168.0.101 255.255.255.0 192.168.0.1 off
DHCP           : OFF
IP address     : 192.168.0.101
Subnet mask    : 255.255.255.0
Default gateway: 192.168.0.1
Web config.    : OFF
MAC address    : 00:40:9d:2c:d2:05
Status         : Connected
OK
>
```

Wireless LAN Configuration

The settings of the WLAN interface are described in Table 17. The current settings can be viewed on the serial line or using the device information display; see section Device Information on page 106.

- CCMP encryption is called **AES** in some networking products.
- The WLAN interface supports both WPA and WPA2 (also known as 802.11i) security when either WPA-PSK mode is selected.
- If your WLAN network is using some other security method than listed below, you must set up a temporary WLAN network with any of these settings and then use the web configuration to set WLAN security settings for the actual network. See section Web Configuration for LAN and WLAN on page 86.

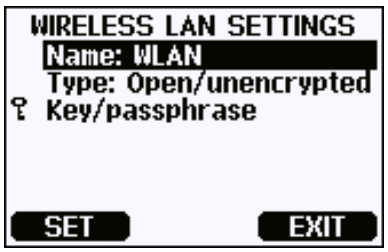
Table 17 Wireless LAN Settings

Parameter	Description
SSID	The service set identifier (that is, network name) of the wireless network to connect to. 1 … 32 characters.
Security type	The security type of the wireless network. The options are: OPEN OPEN/WEP WPA-PSK/TKIP WPA-PSK/CCMP All other choices except OPEN require a security key; see below.
Security key	The encryption key or passphrase that is used with an encrypted network.

Using Display/Keypad

You can configure the Wireless LAN settings using the display/keypad as follows:

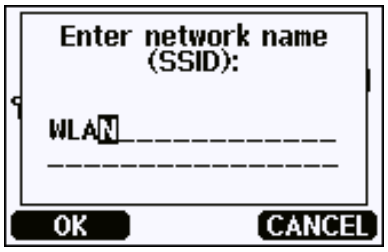
1. Press any of the arrow buttons to open the **Main Menu**.
2. Press the ► arrow button to select **Interfaces**.
3. Press the ► arrow button to select **Network settings**. There will be a delay as the transmitter refreshes the network information.
4. Press the ► arrow button to select **Wireless LAN settings**.



0802-111

Figure 52 Wireless LAN Settings

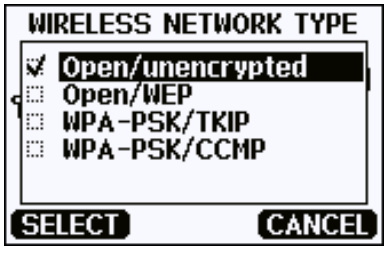
5. The **Name** entry on the page shows the SSID of the currently selected wireless network. To change the SSID, press the **SET** button. Use the ▲▼ arrow buttons to change the character under the cursor, and ◄► arrow buttons to more the cursor. Press the **OK** button when done.



0802-110

Figure 53 Entering Network SSID

6. To change the currently selected Network type, select the **Type** entry and press the **Change** button. Select the new type from the list and press the **Select** button.



0802-112

Figure 54 Selecting the Wireless Network Type

7. If you have selected an encrypted network type (WEP or WPA), you must enter the security key to be used. Select the **Key/passphrase** entry and press the **Set** button. Enter the key in the same way as the SSID, and press the **OK** button. With the WEP encryption you must enter the encryption key in hexadecimal (10 hexdecimals for 64-bit encryption or 26 hexadecimals for 128-bit encryption). A WPA key must be 8 … 63 ASCII characters.
8. After setting the wireless network parameters, press the **Exit** button in the **Wireless LAN Settings** menu. You will be asked to confirm the new settings. Note that when new settings are saved, all currently active WLAN connections are disconnected.

Using Serial Line

Use the serial line command **WLAN** to view or set the wireless network settings. If you set an encrypted network type, you will be asked to enter the security key. With the WEP encryption you must enter the encryption key in hexadecimal (10 hexdecimals for 64-bit encryption or 26 hexadecimals for 128-bit encryption) or with plain ASCII characters (5 characters for 64-bit encryption or 13 characters for 128-bit encryption). A WPA key must be 8 … 63 ASCII characters.

WLAN [*SSID TYPE*]<cr>

where

SSID	=	Network name in 1 … 32 characters
TYPE	=	Security type of the wireless network. The options are: OPEN OPEN/WEP WPA-PSK/TKIP WPA-PSK/CCMP

Examples:

```
>wlan ?
Network SSID   : WLAN-AP
Type           : OPEN
>

>wlan accesspoint wpa-psk/tkip
Network SSID   : accesspoint
Type           : WPA-PSK/TKIP
WPA-PSK phrase ? thequickbrownfox
Save changes (Y/N) ? y
OK
>
```

Communication Protocol

When a Telnet connection is established via the LAN or WLAN interface, the session has the same communication mode, run interval, poll address and echo settings as the serial port (user port) session would have.

These settings can be changed using the display/keypad, using the serial line (user port or service port), or on-the-fly during the Telnet session.

The display menu path to the Communication Protocol settings is: **Main Menu ► Interfaces ► Network Interface ► Communication Protocol**.

The commands for changing the settings are **SMODE**, **INTV**, **ADDR**, and **ECHO**.

Web Configuration for LAN and WLAN

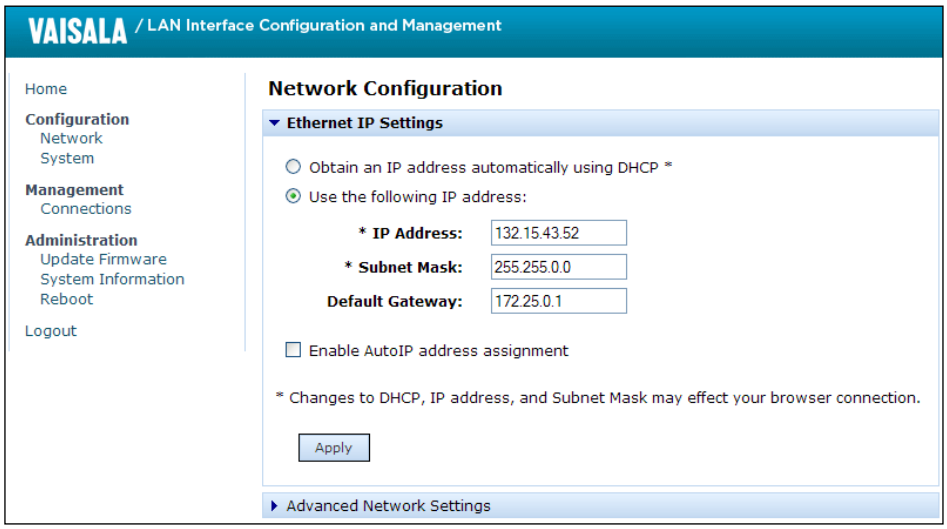
The LAN and WLAN interfaces both have a web configuration page that is accessible using a browser. If you have not disabled the page from the network settings, you can access it with a web browser at the IP address of the interface. You can check the currently assigned IP address of the interface from the device information screens (see Device Information on page 106), or from the serial line by issuing the **net ?** command.

When accessing the web configuration page, you must first log in.

Username: **user**
Password: **vaisala**

The web configuration page provides similar network configuration options as the serial line and the display/keypad. It also has additional options for advanced users. For example, there are more options for securing the wireless network.

If these additional options are used, they will appear as custom configurations when viewed from the serial line or the display/keypad.



1102-017

Figure 55 Web Configuration Interface for WLAN

Terminal Program Settings

The instructions below describe how to connect to the transmitter using the PuTTY terminal application for Windows. Perform the necessary cabling and configuration of the transmitter before following the instructions.

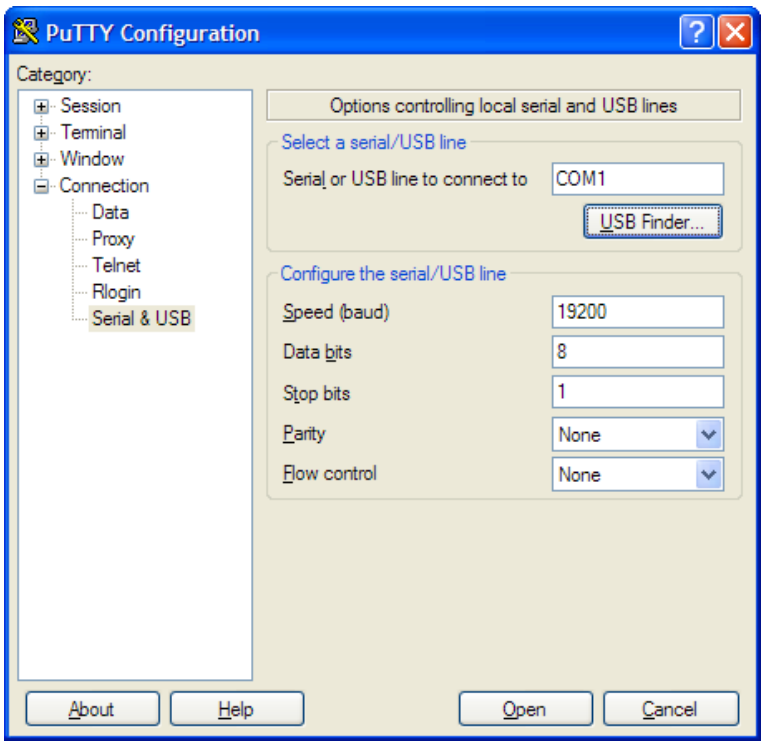
PuTTY is available for download at www.vaisala.com.

NOTE	PuTTY cannot be used to access the transmitter through the User Port if the transmitter is configured to use the Modbus protocol. However, you can always use PuTTY to access the transmitter through the Service Port.

Opening a Serial/USB Connection

1. Power up the transmitter and start the PuTTY application.
2. Select the Serial & USB settings category, and check that the correct COM port is selected in the **Serial or USB line to connect to** field. Change the port if necessary.

   If you are using a Vaisala USB cable, you can check the port that it uses by clicking the **USB Finder...** button. This opens the *Vaisala USB Instrument Finder* program that has been installed along with the USB drivers.
3. Check that the other serial/USB line settings are correct for your connection, and change if necessary. The default settings (shown in Figure 56 below) are used by the Service Port of the transmitter.



0810-070

Figure 56 Opening a Serial Connection

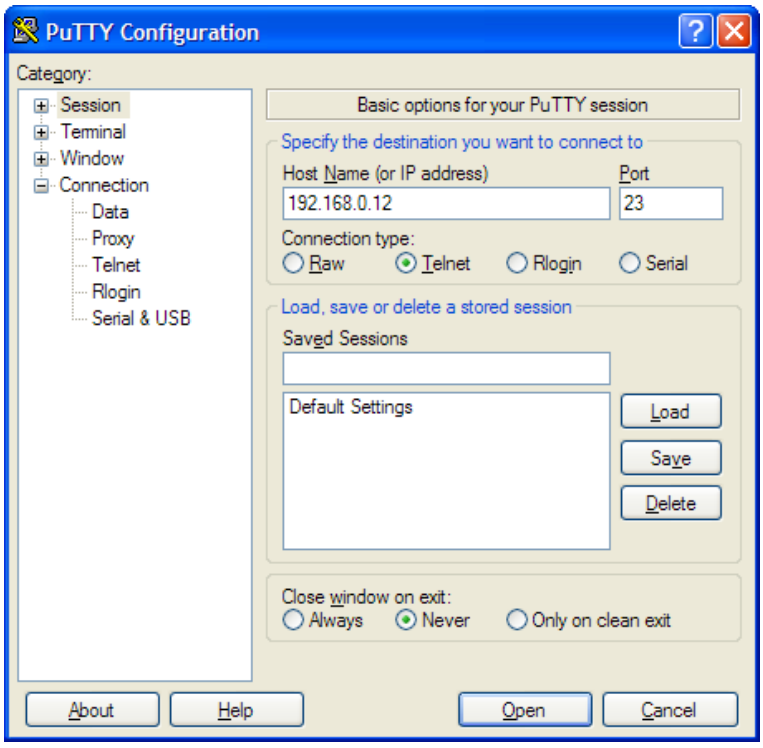
4. Click the **Open** button to open the connection window and start using the serial line.

   If PuTTY is unable to open the serial port you selected, it will show you an error message instead. If this happens, restart PuTTY and check the settings.

Opening a Telnet Session (LAN/WLAN)

NOTE	The instructions below assume that the LAN/WLAN interface on the transmitter is correctly configured and the network connection is already done.

1. Power up the instrument and start the PuTTY application. If your transmitter acquires a network address using DHCP, wait for a minute for this to complete, then verify the address from the transmitter.
2. In the Session window, select the **Telnet** connection type.
3. Enter the IP address of your transmitter in the **Host Name (or IP address)** field. Use the default Telnet port **23**.



0810-071

Figure 57 Opening a Telnet Connection

4. Click the **Open** button to open the connection window and start using the Telnet session.

   If PuTTY is unable to connect the IP address you entered, it will show you an error message instead. If this happens, check the IP address and the connections, restart PuTTY, and try again.

List of Serial Commands

All commands can be issued either in uppercase or lowercase. In the command examples, the keyboard input by the user is in **bold** type.

The notation <cr> refers to pressing the carriage return (**Enter**) key on your computer keyboard. Enter a <cr> to clear the command buffer before starting to enter commands.

In the tables below, the **bold** text in the brackets is the default setting.

Table 18 Measurement Commands

Command	Description
R	Start the continuous outputting
S	Stop the continuous outputting
INTV [**0** ... 255 **S**/MIN/H]	Set the continuous output interval (for RUN mode)
SEND [0 ... 255]	Output the reading once
DSEND	Output the reading once from all connected transmitters (in STOP or POLL mode)
SMODE **[STOP**/RUN/POLL/MODBUS]	Set the serial interface mode
SERI [baud p d s]	User Port settings (Default: 4800 E 7 1)
ADDR **[0** ... 255]	Set the transmitter address (for POLL and MODBUS modes)
NET	View or set networking parameters for LAN and WLAN interfaces
WLAN	View or set wireless network parameters for WLAN interface
OPEN **[0** ... 255]	Open temporarily connection to a POLL mode device
CLOSE	Close the temporary connection (back to POLL Mode)

Table 19 Formatting Commands

Command	Description
FORM	Set the output format of SEND and R commands
FST	Add the state of AutoCal, purge and sensor warming in connection with SEND and R commands
SCOM	Assign a new command name that works like the SEND command
FDATE	Add date to R and SEND outputs
FTIME	Add time to output to SEND and R outputs

Table 20 Data Recording Commands

Command	Description
DIR	Lists trend log files
PLAY [0 ... 24] [START END]	Output recorded data file. Start and end times can only be specified if the data logger module is installed. The times must be given in the following format: yyyy-mm-dd hh:mm:ss
DSEL	Select logged (and displayed) quantities (1 ... 4)
DELETE	Delete all data files, including the memory of the optional data logger module
UNDELETE	Recover the deleted files that have not been overwritten

Table 21 Purge Commands

Command	Description
PUR	Purge settings
PURGE	Start manual purge

Table 22 Autocalibration Commands

Command	Description
AUTO	AutoCal settings
AUTOCAL	Start manual AutoCal

Table 23 Calibration and Adjustment Commands

Command	Description
FCRH	RH two-point adjustment
AØ1	Td/f one-point adjustment
CT	T one or two-point-adjustment
ACAL	Perform analog output adjustment

Table 24 Setting and Testing the Analog Outputs

Command	Description
ASEL	Configure analog output quantities and scales
ITEST	Test analog outputs
AMODE	Display analog output mode
AERR	Change the error output
ASCL	Analog output scaling
AOVER [ON/**OFF**]	Extend analog output range by 10%

Table 25 Setting and Testing the Relays

Command	Description
RSEL	Configure relay settings
RTEST	Test relays

Table 26 Other Commands

Command	Description
?	Output the information about the device
??	Output the information about the device in POLL-state
ALSEL	Set display alarms
CON	Set display contrast
CDATE	Display the output date/set date when adjustment enabled
CODE	Display the order configuration code of the transmitter
CTEXT	Display the adjustment information text/set information text when adjustment enabled
DATE	Set date.
DSEND	Output the reading, also in poll mode.
ECHO	Turn the serial interface echo ON/OFF
ERRS	Display transmitter error messages
FIND	All devices in POLL mode send their addresses
HELP	List the currently available commands
LIGHT	Set the display backlight mode
LOCK	Lock the menu or disable the keypad
MODBUS	View Modbus diagnostic counters
MODS	View information about connected modules
PRES	Set the value for pressure compensation
RESET	Reset the device
TEST	Self-diagnostics information
TIME	Set time.
UNIT	Display output units
VERS	Display the software version information
XPRES	Set pressure (temporarily)
MOL/MOLI	View/set mole weight parameter

Getting Measurement Message from Serial Line

Starting Continuous Outputting

R

Enter the **R** command to start the continuous output of measurements.

Example:

```
>r
Tdf=-20.6 'C H2O=   958 ppmV x=   0.6 g/kg

>r
Tdf=-20.7 'C H2O=   958 ppmV T= 23.8 'C RH=  3.3 %RH
>
```

If a value is too long to fit to the allocated space in the output, or if there is an error in outputting the quantity, the value is displayed with stars '*'.

You can change the format of the output with the following commands:

- Outputting interval can be changed with the **INTV** command.
- Output message format can be changed with the **FORM** command.

Stopping Continuous Outputting

S

Use the **S** command to end the RUN mode. After this command all other commands can be used. You can also press the **Esc** button or reset the transmitter to stop the outputting.

See command **SMODE** to change the default (power-up) operation mode.

Outputting Reading Once

Use the **SEND** command to output the reading once in STOP mode. The output format depends on which parameters the transmitter can output.

SEND<cr>

Examples:

```
>send
Tdf= -5.8 'C H2O=  3715 ppmV x=   2.3 g/kg

>send
Tdf= -5.9 'C Td= -6.6 'C Tdfa= -5.9 'C Tda= -6.6 'C H2O=
3696 ppmV x=   2.3 g/kg  RH= 13.9 %RH a=  2.7 g/m3   aNTP=
3.0 g/m3   T= 22.2 'C dT= 28.1 'C
```

Assign an Alias for the SEND Command

Use the **SCOM** command to assign a new command that works like the **SEND** command. The standard **SEND** command of the transmitter will always function normally whatever the **SCOM** definition may be. Command names are case-insensitive.

SCOM<cr>

Example (assigning the command **MEASURE** as an alias for the **SEND** command):

```
>scom
Send command   :   ? measure
>measure
Tdf= -5.8 'C H2O=  3715 ppmV x=   2.3 g/kg
>
```

You can remove the **SCOM** definition by pressing **Esc** when entering the command name:

```
>scom
Send command   : measure ? <esc>
>
```

Outputting Reading Once From All Transmitters

Use the **DSEND** command to output the reading once from all connected transmitters that are in STOP or POLL modes. In order to avoid data collisions, the transmitters will send their response after a suitable delay. The response includes the transmitters's address, followed by their measurement message.

NOTE	The total execution time of the **DSEND** command depends on the bit rate of the serial port connection. At slow speeds, it will take a considerable amount of time for devices with large address number to respond. The delay will be the same even if there are no other devices at all.

DSEND<cr>

Example (transmitters with addresses 3 and 25 responding):

```
>dsend
  3 Tdf= -5.8 'C H2O=  3715 ppmV x=   2.3 g/kg
 25 Tdf= -1.1 'C H2O=  5549 ppmV x=   3.5 g/kg
>
```

Communicating with a Transmitter in POLL Mode

OPEN

When all transmitters on the RS-485 bus are in POLL mode the **OPEN** command sets one transmitter temporarily to STOP mode so that other commands can be entered.

OPEN [*aa*]<cr>

where

aa = Address of the transmitter (0 ... 255)

CLOSE

The **CLOSE** command switches the transmitter back to the POLL mode.

Example:

```
>OPEN 2     (opens the line to transmitter 2, other
transmitters stay in POLL mode)

>CRH        (for example, calibration performed)
...
>CLOSE      (line closed)
```

Formatting Serial Line Message

NOTE	Instead of using the **FTIME**, **FDATE** and **FST** commands described in this section, you can use the **FORM** command with modifiers TIME, DATE, and STAT. See section FORM on page 98.

FTIME and FDATE

FTIME and **FDATE** commands will enable/disable output of time and date to the serial line. To add time to **R** and **SEND** outputs enter:

FTIME [*x*]<cr>

To add date to **R** and **SEND** outputs enter:

FDATE [*x*]<cr>

where

x = ON or OFF

Example:

```
>send
RH= 16.2 %RH T= 22.0 'C
>ftime on
Form. time     : ON
>send
00:03:56 RH= 16.2 %RH T= 22.0 'C
>fdate on
Form. date     : ON
>send
2000-01-01 00:04:08 RH= 16.2 %RH T= 22.0 'C
>
```

FST

Use the **FST** command to include the status of purge, sensor warming and AutoCal in output from the SEND and R commands.

FST [*x*]<cr>

where

x = ON or OFF (default)

Example:

```
>fst on
Form. status   : ON
>send
w     0 Tdf=  0.6 'C x=   4.0 g/kg  SSR= 22.5 %  Ts= 23.2
'C
>
```

where the state of the probe is indicated by the following letters and values:

w...xxx	=	Sensor warming	where xxx	=	Sensor heat power (0 when not warming)
H...xxx	=	Purge	where xxx	=	Sensor temperature (ºC)
S...xxx	=	Sensor cooling after purge	where xxx	=	Sensor temperature (ºC)
A...xxx	=	AutoCal	where xxx	=	Sensor temperature (ºC)

General Settings

Changing Quantities and Units

To change quantities and units use serial commands or the optional display/keypad. See Table 5 on page 20 for available quantities.

NOTE	Only the quantities selected when ordering the device can be selected as an output quantity.

Using Display/Keypad

Use display/keypad to select the display output quantities.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Press the ► arrow button to select **Display**.
3. Press ► arrow button to select **Quantities**.
4. Select the quantity by using the ▲▼ arrow buttons. Confirm the selection by pressing **SELECT**. You can select 1 ... 4 display quantities at a time.
5. Press **EXIT** to return to the basic display.

To select display units:

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.

2. Press the ► arrow button to select **Display**.
3. Use the ▲▼arrow buttons to select **Units**. Confirm the selection by pressing the right-hand arrow button.
4. Use the ▲▼ arrow buttons to select display units. Confirm the selection by pressing **CHANGE**. The unit changes from metric to non-metric or the other way round.
5. Press **EXIT** to return to the basic display.

NOTE	Changing the units by using the display/keypad has no effect on the serial output units.

Using Serial Line

Use the serial line command **FORM** to change the format, and the command **UNIT** to select metric or non-metric output units.

FORM

Use the serial line command **FORM** to change the format or select a certain quantities for the output commands **SEND** and **R**.

FORM [*x*]<cr>

where

x = Formatter string

Formatter string consists of quantities and modifiers. If no formatter string is entered, the command will display the currently active formatter string. Note that the hash symbol "#" is shown as a backslash "\" when viewing the current formatter string.

When selecting the quantity, use the abbreviations of the quantities presented in Table 5 on page 20 when issuing the command. The modifiers are presented in Table 27 on page 99.

Table 27 FORM Command Modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
""	String constant
#xxx	Special character, code "xxx" (decimal), for example #027 for ESC
U5	Unit field and length (length optional)
ADDR	Transmitter address [00...255]
ERR	Error flags for P, T, Ta, RH [0000 ... 1111], 0 = no error
STAT	Transmitter status in 7 character field, for example: N 0 no heating h 115 probe heating active, power 115/255 H 159.0 purge heating active, temperature 159 ºC S 115.0 purge cooling active, temperature 115 ºC X 95.0 sensor heating active, temperature 95 ºC
SN	Transmitter serial number
TIME	Time [hh:mm:ss]
DATE	Date [yyyy-mm-dd]
OK	Pressure stability indicator, two characters [OK or " "]
CS2	Modulus-256 checksum of message sent so far, ASCII encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation

Example:

```
>form "SSR=" 4.2 ssr U5 #t "Ts=" ts U3 #r #n
OK
>send
SSR=  22.51%            Ts=  23.14'C
```

Command '**FORM /**' will return the default output format. The default output format depends on the device configuration.

```
>form /
OK
>send
Tdf=  0.5 'C x=   4.0 g/kg  SSR= 22.4 %  Ts= 23.1 'C
```

UNIT

Use the **UNIT** command to select metric or non-metric output units, and change the unit for the H2O quantity:

UNIT [*x*]<cr>

where

x = Unit system to be used. Options are:
M (metric units)
N (non-metric units)

UNIT H2O [y]<cr>

where

y = Unit to be used for H20. Options are:
PPMV (parts per million by volume)
PPMW (parts per million by weight)

NOTE This command changes both the serial output and display units to either metric or non-metric units. When you want to output both metric and non-metric units simultaneously on the display, select the display units by using the display/keypad.

Examples:

```
>unit m
Output units   : metric
>

>unit h2o ppmv
H2O units      : ppmV
>
```

Use the **MOL/MOLI** command to view/set mole weight parameter that will be used in calculating H_2O $ppm_{w.}$

Pressure Compensation Setting

The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the process pressure is taken into consideration. If you are using mixing ratio as an output quantity, it is recommended that you make the pressure compensation setting.

Note that conversions from mmHg and inHg are defined at 0°C and for mmH_2O and inH_2O at 4°C.

NOTE	Pressure compensation is intended to be used in normal air only. When measuring in other gases, please contact Vaisala for further information.

NOTE	Fixed pressure compensation value of 1013.25 hPa is used when in adjustment mode.

Using Display/Keypad

Use display/keypad to set the pressure compensation. To select the pressure unit using display/keypad see section Changing Quantities and Units on page 97.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Measuring** and press the ►arrow button to confirm your selection.
3. Select **Pressure compensation** and press the ► arrow button to confirm you selection.
4. Press **SET** and enter the pressure value by using the arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Using Buttons on Motherboard

Pressure set buttons (**P_{chk}** and **P_{set}**) can be used to set the process pressure.

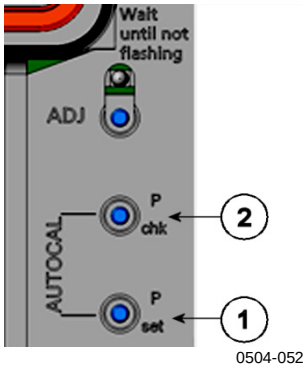


Figure 58 Pressure Set Buttons on Motherboard

The following numbers refer to Figure 58 above:

1 = Pressure set button
2 = Pressure check button

Press check button (**P_{chk}**) and a red LED will flash the current pressure setting in bar_a.

Press the set button (**P_{set}**) to set the pressure value. The number of presses equals the number of bar_a to be set (for example, three presses = three bar_a). After a few seconds, the red LED will confirm the setting by flashing the new pressure value.

Using Serial Line

XPRES and PRES

Command **XPRES** must be used if the value is changed frequently (for example, by an automatic system that updates the value). Its value is not retained at reset, and when set to 0; last value set with **PRES** is used instead. Use the serial line and do the following:

PRES [*aaaa.a*]<cr>

XPRES [*aaaa.a*]<cr>

where

aaaa.a = Absolute process pressure (hPa)

Examples:

```
>pres
Pressure       : 1013.00 hPa ?
>pres 1010
Pressure       : 1010.00 hPa
>
```

Table 28 Conversion Factors for Pressure Units

From	To: hPa
mbar	1
PaN/m2	0.01
mmHg torr	1.333224
inHg	33.86388
mmH_2O	0.09806650
inH_2O	2.490889
atm	1013.25
at	980.665
bar	1000
psi_a 1)	68.94757

1) psi_a = psi absolute

Example:

29.9213 inHg = 29.9213 × 33.86388 hPa = 1013.25 hPa

Date and Time

Using Display/Keypad

If the optional Data Logger Module is installed, you can change the time and date using the display/keypad.

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **System** and press the ► arrow button to confirm your selection.
3. Select **Date and time** and press the ► arrow button.
4. Press the **SET** button to enter the adjustment mode, and use the arrow buttons to select and change the values.
5. You can also change the date and time formats that are shown in the graphs. The selected formats are only used in graphical display, they do not change the formats that are used in the serial communication.
6. Press **EXIT** to return to the basic display.

Using Serial Line

To set time enter the **TIME** command. To set date enter the **DATE** command.

TIME<cr>

DATE<cr>

These time and date settings are shown on the timestamps of **PLAY** command. When you want to include time and date in the **R** and **SEND** commands, use the **FTIME** and **FDATE** commands.

Example:

```
>time
Time            : 13:42:49 ?

>date
Date            : 2007-05-31 ?
```

NOTE	If the optional Data Logger Module is not installed, time and date available on the serial ports (only) are cleared to 2000-01-01 00:00:00 at reset or at power failure.

Data Filtering

The averaging data filter calculates a average over a certain period of time. The lowest measurement noise is achieved with the extended filtering. There are three filtering levels available.

Table 29 Filtering Levels

Setting	Filtering Level
OFF	No filtering.
STANDARD	Standard filtering, enabled by default. Approximately 13 s moving average.
EXTENDED	Extended filtering. Approximately 1 min average by default, but configurable on the serial line.

Use display/keypad to set the filtering level.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Measuring** by pressing the ► arrow button.
3. Select **Filtering** and press **CHANGE** to confirm your selection.
4. Select **Off/Standard/Extended** and press **SELECT** to confirm your selection.
5. Press **EXIT** to return to the basic display.

FILT

Use the serial line command **FILT** to set the filtering level.

FILT [*level*] [*extfactor*]<cr>

where

level = Filtering level. The options are:

OFF (no filtering)
ON (standard filtering, enabled by default. Approximately 13 s moving average)
EXT (extended filtering, approximately 1 min average by default but configurable by changing the extfactor)

extfactor = Weighted average factor for extended filtering level. Range 0 ... 1, default 0.030.

In extended filtering mode, the output is calculated based on the following formula:
[(new result * extfactor) + (old result * (1.0 - extfactor))]
This means that with extfactor value 1 the transmitter will take only the latest measurement into account, but with extfactor value 0.1 a new output is a combination of the previous output (90%) and the latest measurement (10%).

Example (enable extended filtering):

```
>filt ext
Filter          : EXT
>
```

Device Information

Use the display/keypad or the serial line to display the device information.

Press the **INFO** button in the basic display to see the following information:

- Current sensor operation (for example, AutoCal or Purge) in progress
- Present or past unacknowledged errors
- Device information
- Current date and time (only shown if data logger module installed)
- Adjustment information fed by the user
- Measuring settings
- Information on Purge settings
- Display Alarm settings
- Serial interface information
- Network settings and status of the LAN and WLAN interfaces
- Analog output information
- Relay output information

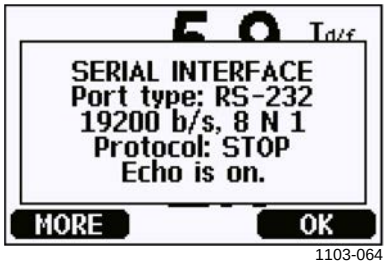


Figure 59 Device Information on Display

Proceed in the information views by pressing the **MORE** button repeatedly until you get the desired information. You can browse through the information displays also with arrow buttons. Press **OK** to return to the basic display.

?

Use the serial line command **?** to check the current transmitter configuration. Command **??** is similar but can also be used if the transmitter is in POLL mode.

Example:

```
>?
DMT340 / 5.10.0
Serial number  : D1120014
Batch number   : D0750009
Adjust. date   : 2008-08-16
Adjust. info   : Helsinki / FIN
Date           : 2000-01-02
Time           : 05:12:27
Serial mode    : STOP
Baud P D S     : 19200 N 8 1
Output interval: 10 s
Address        : 0
Echo           : ON
Pressure       : 1013.25 hPa
Filter         : OFF
Ch1 output     : 0...1V
Ch2 output     : 0...1V
Ch1 Tdf   low  : -20.00 'C
Ch1 Tdf   high : 100.00 'C
Ch2 H2O   low  : 0.00 ppmV
Ch2 H2O   high : 5000.00 ppmV
Module 1       : not installed
Module 2       : not installed
>
```

LIGHT

Use the **LIGHT** command to view or set the backlight mode of the display (optional). Issuing the command without specifying a mode shows the current backlight mode.

LIGHT [*mode*]<cr>

where

mode = The operating mode of the display backlight. The options are:

ON (backlight always on)
OFF (backlight always off)
AUTO (backlight automatically turns on and off when keypad is used)

Example:

```
>light
Backlight      : OFF
>light auto
Backlight      : AUTO
>
```

HELP

Use the **HELP** command to list the currently available commands. The available commands are determined by the device configuration and installed options.

Example:

```
>help
?         ACAL      ADDR      AERR      ALSEL
ASEL      AUTO      AUTOCAL   CDATE     CLOSE
CON       CT        CTEXT     DATE      DELETE
DIR       DSEL      DSEND     ECHO      ERRS
FCRH      FILT      FORM      HELP      IK0
INTV      ITEST     LIGHT     LOCK      MODBUS
MODS      MOL       MOLI      NET       PLAY
PRES      PUR       PURGE     R         RESET
SCOM      SDELAY    SEND      SMODE     SWARM
SYSTEM    TEST      TIME      UNDELETE  UNIT
VERS      XPRES
>
```

ERRS

Use the **ERRS** command to display transmitter error messages, see Table 33 on page 147.

Example (no active errors):

```
>errs
No errors
>
```

Example (showing active error):

```
>errs
Error: E2  Humidity sensor open circuit.
>
```

MODS

Use the **MODS** command to display information about the optional modules that are connected to the transmitter.

Example:

```
>mods
Module 1       : WLAN-1 (POST: release_82000941_J; FW:
Version 82000977_K1 10/16/2008)
Module 2       : LOGGER-1       (1024 MB; HW: B; SW: 5)
>
```

VERS

Use the **VERS** command to display software version information.

Example:

```
>vers
DMT340 / 5.10
>
```

Resetting the Device

Use the serial line to reset the device. Use the **RESET** command to reset the device. The user port switches to start-up output mode selected with command **SMODE**.

Locking Menu/Keypad Using Serial Line

LOCK

Use the **LOCK** command to prevent the user from entering the menu using the keypad, or to lock the keypad completely. You can optionally set a 4-digit PIN code, for example 4444.

If a PIN code has been set, the user will be prompted to enter the code when trying to access the menu. Entering the code correctly will disable the lock until the user returns back to the basic view.

LOCK [*x*] [*yyyy*]<cr>

where

x	=	Keypad locking level, range 0...2. The options are: 0 - No lock (enables full access) 1 - Menu locked, but graphs are accessible 2 - Keypad completely disabled
yyyy	=	4-digit PIN code. The code can only be set when keypad locking level is 1.

Examples:

```
>lock 1 4444
Keyboard lock  : 1 [4444]
>

>lock 1
Keyboard lock  : 1
>
```

Serial Output Settings

The communication settings for the user port can be changed via the serial line or by using the optional display/keypad. The communication settings for the service port are fixed and not changeable.

NOTE	If a communication module (LAN, WLAN, or RS-422/RS-485 interface) has been installed, the user port is not accessible. Any changes to the settings are applied to the interface provided by the module, if applicable.

Using Display/Keypad

1. Press any of the arrow buttons to open the **Main Menu**.
2. Select **Interfaces** and press the ►arrow button to confirm your selection.
3. Select **Serial interface** and press the ►arrow button to confirm your selection.
4. Select **Bit rate** and **Serial format** by pressing the **CHANGE** button. Use the ▲▼ arrow buttons to select and press **SELECT** to confirm your selection.
5. Select the **Protocol** to be used by the serial output by pressing the **CHANGE** button. Select the option using the ▲▼ arrow buttons and press **SELECT.** This is the same serial mode setting that is changed by the **SMODE** serial command.
   - **RUN** mode continuously outputs the measurement message at the set interval. If you select the RUN mode, set the desired **RUN interval** also.
   - **POLL** mode enables multiple transmitters to share the same RS-485 line. If you select the POLL mode, select the **Device address** also, as each transmitter on the line must have an unique address.
   - In **STOP** mode, transmitter remains silent after reset or power up, waiting for commands.
   - In **MODBUS** mode, only Modbus protocol communication is available. See Chapter 5, Modbus, on page 137.
6. Select the **RUN interval** and the unit. Press **OK** to confirm.
7. Select the **Device address** and press **SET** to confirm.
8. Select **ECHO,** and press **ON** to turn to it on, **OFF** to turn it off.
9. Press **EXIT** to return to the basic display.

The new user port settings set using the display/keypad are effective immediately.

Using Serial Line

NOTE	You can use the serial commands to change/view the user port settings even if you are currently connected to the service port.

SERI

Use the **SERI** command to set the communication settings for the user port. Changed settings will be activated at next reset or power up.

SERI [*b p d s*]<cr>

where

b = Bit rate (110, 150, 300, 600, 1200, 2400, 4800, 9600,19200, 38400, 57600, 115200)
p = Parity (n = none, e = even, o = odd)
d = Data bits (7 or 8)
s = Stop bits (1 or 2)

The settings can be changed one parameter at a time or all parameters at once.

Example (changing all parameters):

```
>SERI 600 N 8 1
600 N 8 1
>
```

Example (changing parity only):

```
>SERI O
4800 O 7 1
```

SMODE

Use the **SMODE** command to set the user port start-up operating mode.

SMODE [*xxxx*]<cr>

where

xxx = STOP, RUN, POLL, or MODBUS.

Table 30 Selection of Output Modes

Mode	Measurement Output	Available Commands
STOP	Only with the **SEND** command.	All (default mode).
RUN	Automatic output.	Only command **S.**
POLL	Only with the **SEND** [*addr*] command.	**SEND** [*addr*] and **OPEN** [*addr*]. Other commands available after opening a line to the transmitter using the **OPEN** command. Use with RS-485 buses where multiple transmitters can share the same line.
MODBUS	Must be read from the transmitter using MODBUS protocol.	Modbus protocol only; see Chapter 5, Modbus, on page 137.

Selected output mode will be activated at next reset or power up.

ADDR

Use the **ADDR** command to set the device address of the transmitter. Addresses are required for POLL mode and MODBUS mode (serial Modbus).

ADDR [*aa***]**<cr>

where

aa = Device address of the transmitter, range 0 ... 255 (default = 0)

Example (changing the transmitter address from 0 to 52):

```
>addr
Address        : 0 ? 52
>
```

INTV

Use the **INTV** command to set the RUN mode output interval. The time interval is used only when the RUN mode is active. Setting RUN output interval to zero enables the fastest possible output rate.

INTV [*xxx yyy*]<cr>

where

xxx = Delay, range 0 ... 255.
yyy = Unit: S, MIN or H.

Example (setting the output interval to 10 minutes):

```
>intv 10 min
Output interval: 10 min
>
```

SDELAY

With the **SDELAY** command you can set delay (response time) for user port, or view currently set delay value. Adjusting the delay may be needed when half-duplex communication (typically two-wire RS-485) is used.

The delay value corresponds to tens of milliseconds (for example, 5 = 0.050s minimum answer delay). The value can be set between 0 ... 254.

Example:

```
>sdelay
Serial delay   : 0 ? 10

>sdelay
Serial delay   : 10 ?
```

ECHO

Use the **ECHO** command to set the user port echo. The command either enables or disables echo of characters received.

ECHO [*x*]<cr>

where

x = ON (enabled, default) or OFF (disabled)

NOTE	When using the RS-485 interface with a 2-wire connection, always disable echo. When using a RS-232, RS-422/485 4-wire connection, LAN, or WLAN, you can enable or disable it as you wish.

Data Recording

Data recording function is always on and collects data automatically into the memory of the device. If the optional data logger module is installed, the transmitter uses it automatically. Recorded data does not disappear from the memory when the power is switched off. Collected data can be observed in a form of a graph in the graphical view of the display or it can be listed out by using the serial line or MI70 Link program.

Selecting Data Recording Quantities

If the device is provided with the optional display, the recorded quantities are always those selected for the display. Up to three quantities can be recorded at a time. See section Changing Quantities and Units on page 97 for instructions on how to select the display quantities with the keypad.

DSEL

Use the serial line command **DSEL** [*xxx*] to select the quantities to be recorded if the transmitter is not equipped with display/keypad.

You may also dump the logged data to the serial line in numeric form with the following commands.

Syntax: **DSEL** [*xxx*]

where

xxx = Data recording quantity. See Table 5 on page 20 for available output quantities.

Issue the command without parameters and press **Enter** to display the current recording parameters.

Example:

```
>dsel tdf x
 Tdf x
>dsel
 Tdf x
>
```

View Recorded Data

If the device is provided with the optional display, the graphical display shows the data of the selected quantities, one at a time. See section Graphic History on page 65 for details about graphical display.

DIR

Use the serial line and issue the **DIR** command to check the available files.

Without the data logger module, the transmitter records five files (five observation periods) for each selected quantity. The data logger raises the number of recorded files to six for each quantity. Thus, the total amount of the files varies between 5 and 24. See Table 11 on page 65.

Select, for example, two quantities (T and Tdf). The last column illustrates the number of data points that has been stored in the file.

Example (data logger module installed):

```
>dir
   File description          Oldest data available       No. of points
1  T    (90 s intervals)     2007-05-30 05:25:30         1555200
2  T    (12 min intervals)   2007-05-29 05:48:00         194400
3  T    (2 h intervals)      2007-05-19 02:00:00         19440
4  T    (12 h intervals)     2007-03-23 12:00:00         3240
5  T    (3 d intervals)      2006-04-20 00:00:00         540
6  T    (12 d intervals)     2002-12-16 00:00:00         135
7  Tdf  (90 s intervals)     2007-05-30 05:25:30         1555200
8  Tdf  (12 min intervals)   2007-05-29 05:48:00         194400
9  Tdf  (2 h intervals)      2007-05-19 02:00:00         19440
10 Tdf  (12 h intervals)     2007-03-23 12:00:00         3240
11 Tdf  (3 d intervals)      2006-04-20 00:00:00         540
12 Tdf  (12 d intervals)     2002-12-16 00:00:00         135
>
```

Example (without data logger module):

```
>dir
   File description          Oldest data available       No. of points
1  T    (90 s intervals)     2008-04-11 20:41:11         135
2  T    (12 min intervals)   2008-04-10 21:03:41         135
3  T    (2 h intervals)      2008-03-31 18:03:41         135
4  T    (12 h intervals)     2008-02-04 12:03:41         135
5  T    (3 d intervals)      2007-03-04 00:03:41         135
6  Tdf  (90 s intervals)     2008-04-11 20:41:11         135
7  Tdf  (12 min intervals)   2008-04-10 21:03:41         135
8  Tdf  (2 h intervals)      2008-03-31 18:03:41         135
9  Tdf  (12 h intervals)     2008-02-04 12:03:41         135
10 Tdf  (3 d intervals)      2007-03-04 00:03:41         135
>
```

PLAY

Use the **PLAY** command to output the selected file to the serial line. If the data logger module is installed, you can specify an interval to be outputted.

Data in the output is <TAB> delimited. This is compatible with most spreadsheet programs. Before giving the command, set the local date and time with **TIME** and **DATE** commands, if needed.

PLAY [*x*] [*start_date start_time end_date end_time*]<cr>

where

x	=	Number of the data file that will be outputted, range 0 ... 18. The numbers correspond to the output of the DIR command; refer to the example on page 115. Selecting number 0 will output all data files.
start_date	=	Starting date of the interval to be outputted. Must be given in the following format: yyyy-mm-dd.
start_time	=	Starting time of the interval to be outputted. Must be given in the format hh:mm:ss or h:mm.
end_date	=	Ending date of the interval to be outputted. Must be given in the following format: yyyy-mm-dd.
end_time	=	Ending time of the interval to be outputted. Must be given in the format hh:mm:ss or h:mm.

Example:

```
>play 7 2007-05-05 00:00:00 2007-05-06 00:00:00
Tdf  (12 min intervals) 2007-05-05 00:00:00  121
Date          Time        trend   min     max
yyyy-mm-dd  hh:mm:ss       'C      'C      'C
2007-05-05  00:00:00  -22.60    -22.63    -22.57
2007-05-05  00:12:00  -22.55    -22.58    -22.53
2007-05-05  00:24:00  -22.50    -22.53    -22.45
2007-05-05  00:36:00  -22.43    -22.45    -22.41
2007-05-05  00:48:00  -22.35    -22.41    -22.32
2007-05-05  01:00:00  -22.31    -22.33    -22.29
...
```

NOTE Output of large amounts of recorded data can result in huge data files and take a long time, up to several days for the entire memory of the data logger. To make it easier to process the data it is recommended to select the largest suitable data interval, and to specify the start and end times carefully.

Deleting Recorded Files

You can delete the recorded data files using the keypad/display, or the **DELETE** command on the serial line. The deletion is always done for all data; you cannot delete individual files.

Note that the transmitter automatically overwrites the old data when the memory is full, so manual deletion of the recorded files is not necessary in normal use.

To delete the data files using the keypad/display:

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **System** by pressing the ► arrow button.
3. Select **Clear graph memories** by pressing the **CLEAR** button. Press the **YES** button to confirm the selection.

CAUTION	This function clears the entire data history of the transmitter, including all graphs and the content of the optional data logger module.

UNDELETE

Similarly to the **DELETE** command, the **UNDELETE** command is used without any arguments. It will recover all deleted data that has not been overwritten yet.

Analog Output Settings

The analog outputs are set in the factory according to the order form. In case you want to change the settings, follow these instructions.

Changing Output Mode and Range

Both output channels have their own dip switch module with 8 switches, see the position in Figure 2 on page 23 (dip switches for analog output settings).

1. Select the current/voltage output, switch ON either of the switches, 1 or 2.
2. Select the range, switch ON one of the switches from 3 to 7.

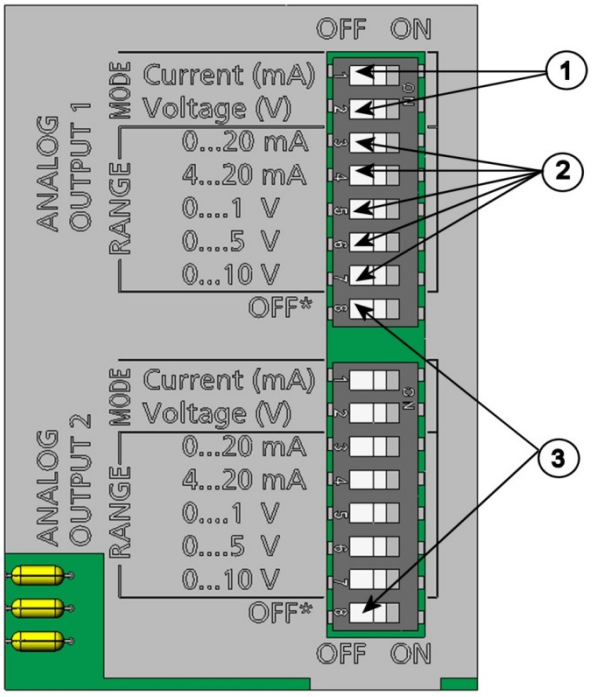


Figure 60 Current/Voltage Switches of Output Modules

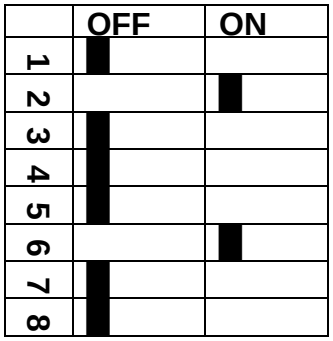
The following numbers refer to Figure 60 above:

1 = Current/voltage selection output switches (from 1 to 2)
2 = Current/voltage range selection switches (from 3 to 7) in analog output 1 and 2
3 = Switches for service use only. Keep in OFF position always.

NOTE	Only set one mode and one range switch to ON for one output channel. The rest of the switches must remain OFF.

Example:

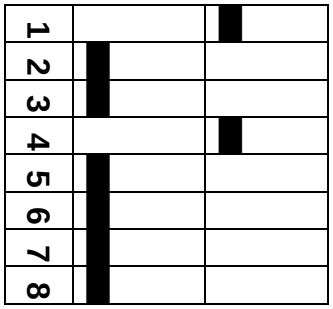
0 ... 5 V voltage output selected for channel 1 and 4 ... 20 mA selected for channel 2.



Selection

Voltage output selected

0 ... 5 V selected



Current output selected

4 ... 20 mA selected

NOTE If you have customized the error output setting (**AERR**), check that the set error values are still valid after changing the output mode/range. See section Analog Output Fault Indication Setting on page 122.

Analog Output Quantities

NOTE The relative humidity and temperature readings are not those of the process itself but the ones measured after the cooling process. Therefore, they should not be selected as output quantities. They are meant to be used in calibration or during installation.

Use the display/keypad to change and scale the analog output quantities.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Interfaces** by pressing the ► arrow button.
3. Select **Analog outputs** by pressing the ► arrow button.
4. Select **Output 1/2/3** by pressing the ► arrow button.

5. Select **Quantity** by pressing the ▲▼ arrow buttons. Confirm your selection by pressing **CHANGE**.
6. Select **the quantity** by using the arrow buttons. Press **SELECT** to confirm your selection.
7. Select **Scale,** lower limit, by pressing the ▲▼arrow buttons. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
8. Select the upper limit by pressing the ▲▼arrow buttons. Use the arrow buttons to set the upper limit value. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
9. Press **EXIT** to return to the basic display.

AMODE/ASEL

Use the serial line to select and scale the analog output quantities. Check the analog output modes with the **AMODE** command.

AMODE<cr>

Example:

```
>amode
Ch1 output     : 0...1V
Ch2 output     : 0...1V
>
```

Select and scale the quantities for the analog outputs with the command **ASEL**. Note that the optional quantities can be selected only if they have been selected when ordering the device.

ASEL [*xxx yyy zzz*]<cr>

where

xxx = Quantity of channel 1
yyy = Quantity of channel 2
zzz = Quantity of the optional analog output channel 3

Always enter all the quantities for all outputs. For quantities and their abbreviations see Table 5 on page 20.

Use the **ASEL** [*xxx yyy*] command as shown in the example below when using a device with two analog outputs.

Example:

```
>asel
Ch1 Tdf   low  : -20.00 'C ?
Ch1 Tdf   high : 100.00 'C ?
Ch2 x     low  : 0.00 g/kg ?
Ch2 x     high : 500.00 g/kg ?
>
```

Analog Output Tests

Use the display/keypad to test the operation of the analog outputs by forcing the outputs to known values. Measure then the values with a current/voltage meter.

Use the display/keypad for testing.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **System** by pressing the ► arrow button.
3. Select **Diagnostics** by pressing the ► arrow button.
4. Select **Analog output tests** by pressing the ► arrow button.
5. Select one of the testing options **Force 0 %/50%/100% of scale.** Press **TEST** to confirm your selection. All outputs are tested simultaneously. The actual output value depends on the selected range.
6. Press **OK** to stop testing. Press **EXIT** to return to the basic display.

ITEST

Use the **ITEST** command to test the operation of the analog outputs. The **ITEST** command forces the analog outputs to entered values. The analog outputs remain at these values until you enter the command **ITEST** without parameters or reset the transmitter.

ITEST [*aa.aaa bb.bbb cc.ccc*]<cr>

where

aa.aaa = Current or voltage value to be set for channel 1 (mA or V)
bb.bbb = Current or voltage value to be set for channel 2 (mA or V)
cc.ccc = Current or voltage value to be set for channel 3 (optional) (mA or V)

Example:

```
>itest 20
Ch1 (Tdf )     :          *        20.000 mA   H'CCD3
Ch2 (x   )     :          *        20.000 mA   H'CCCB
>itest 20 5
Ch1 (Tdf )     :          *        20.000 mA   H'CCD3
Ch2 (x   )     :          *         5.000 mA   H'34BD
>
```

Analog Output Fault Indication Setting

Factory default state for analog outputs during error condition is 0 V/ 0 mA. Please be careful when selecting the new error value. The error state of the transmitter should not cause unexpected problems in process monitoring.

Use the display/keypad to set the analog output fault indication.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Interfaces** by pressing the ► arrow button.
3. Select **Analog Outputs** by pressing the ► arrow button.
4. Select **Output 1/2/3** by pressing the ► arrow button.
5. Select **Fault indication**. Press **SET** to confirm your selection. Enter the fault indication value by using the arrow buttons. Press **OK** to confirm your setting. This value is outputted if a transmitter error occurs.
6. Press **EXIT** to return to the basic display.

AERR

Use the serial line **AERR** command to change the error output.

AERR

Example:

```
>aerr
Ch1 error out  : 0.000V ? 5.0
Ch2 error out  : 0.000V ? 5.0
>
```

NOTE	The error output value must be within a valid range for the output type.

NOTE	The error output value is displayed only when there are minor electrical faults such as a humidity sensor damage. When there is a severe device malfunction, the error output value is not necessarily outputted.

Extend Analog Output Range

Use the **AOVER** command to allow the analog output channels to exceed their specified range by 10%. The scaling of the parameter remains as before; the extra range is used for additional measurement range in the high end of the scale.

AOVER [*ON/OFF*]<cr>

Example:

```
>aover on
Extended output: ON
>
```

The following example illustrates how the analog output is affected. Channel 2 outputs temperature (T) with voltage output 0 … 5 V (0 … 60 °C). After giving the **AOVER ON** command, the range is 0 … 5.5 V (0 … 66 °C). Note that the 60 °C point is still at 5 V.

Operation of Relays

Quantity for Relay Output

A relay monitors the quantity chosen for the relay output. Any of the quantities available can be chosen.

Measurement-Based Relay Output Modes

Relay Setpoints

When the measured value is in between the "above" and "below" values, the relay is passive. When choosing lower value as "above" value and higher value as "below" value, the relay is passive when the measured value is not between the setpoints. You can also set only one setpoint. See Figure 61 on page 124 for illustrative examples of the different measurement-based relay output modes.

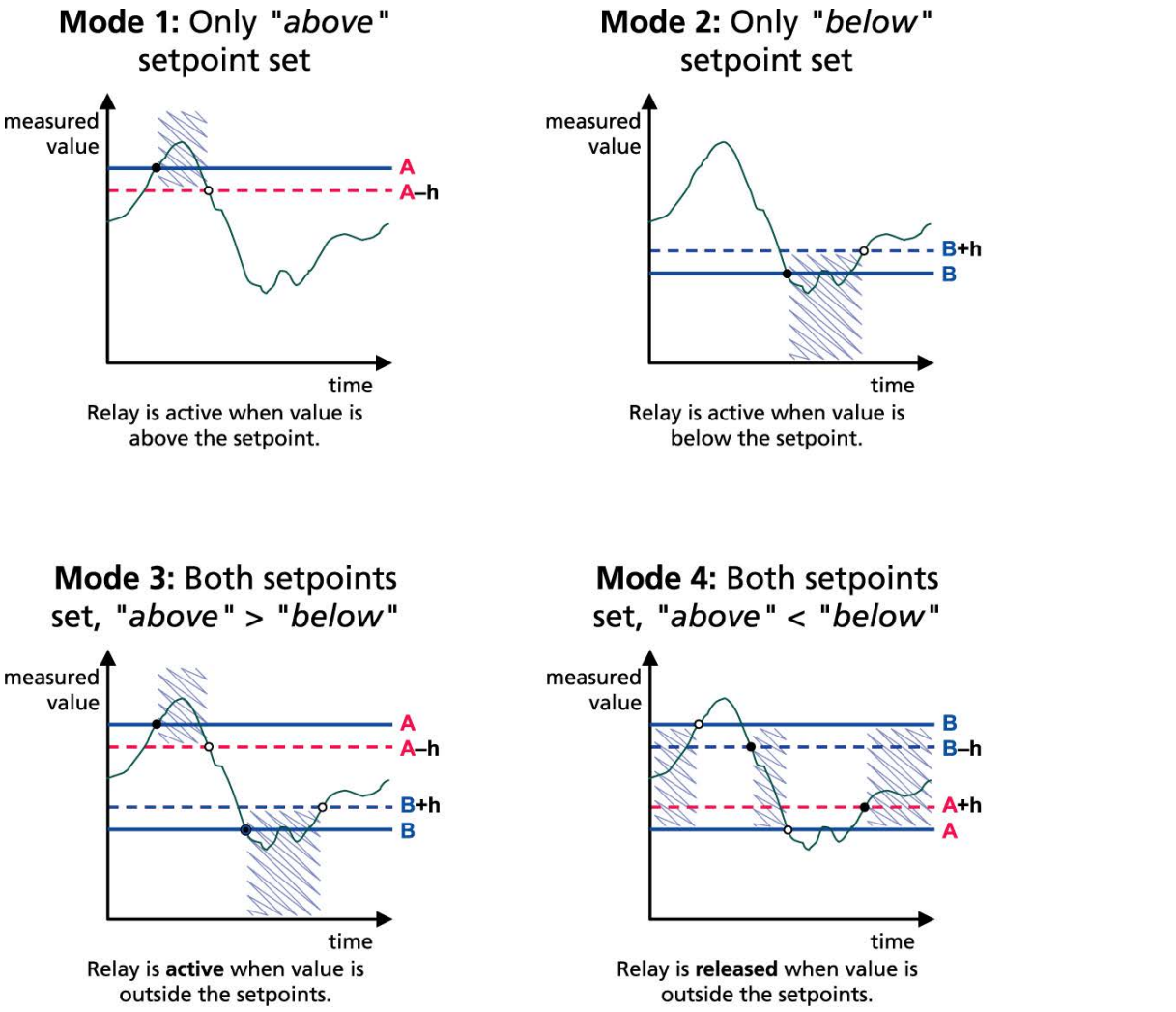


Figure 61 Measurement-Based Relay Output Modes

Mode 4 is usually used if an alarm needs to be triggered when the measured value exceeds a safe range. The relay is active when measurement is in range, and is released if the value goes out of range or the measurement fails.

NOTE	If the measurement of the selected quantity fails or the transmitter loses its power, the relay is released.

Hysteresis

Hysteresis function is to prevent the relay switching back and forth when the measured value is near to the setpoint values.

Relay is activated when the measured value passes the exact value of the setpoint. When returning and passing the setpoint again relay is not released before the value reaches the setpoint increased/decreased by the hysteresis value.

Hysteresis should be smaller than difference of the setpoints.

Example:

When the 'active above' value is 50 ºC and the hysteresis value is 2 ºC, relay activates when the relative humidity reaches 50 ºC. As the humidity then decreases, relay releases at 48 ºC.

```
>rsel tdf ts
Rel1 Tdf  above: 0.00 'C ? 50
Rel1 Tdf  below: 0.00 'C ? -
Rel1 Tdf  hyst : 0.00 'C ? 2
Rel1 Tdf  enabl: OFF ? on
Rel2 Ts   above: 0.00 'C ? 80
Rel2 Ts   below: 0.00 'C ? 60
Rel2 Ts   hyst : 0.00 'C ? 1
Rel2 Ts   enabl: OFF ? on
>
```

NOTE If both setpoints are specified and "above" setpoint is lower than "below" setpoint, the hysteresis works in the opposite direction, that is, relay **is released** when the measured value passes the exact value of the setpoint.

Relay Indicating Transmitter Error Status

You can set a relay to follow the operation status of the device. By selecting FAULT/ONLINE STATUS for output quantity a relay changes state on the basis of the operation status as follows:

FAULT STATUS

Normal operation: relay active (C and NO outputs are closed)

Not measuring state (error state or power off): relay released (C and NC outputs are closed)

ONLINE STATUS

Live measurement (data available): relay active (C and NO outputs are closed)

No live data (for example: error state, chemical purge or adjustment mode): relay released (C and NC outputs are closed)

See Figure 62 below for illustrative examples of the FAULT/ONLINE STATUS relay output modes.

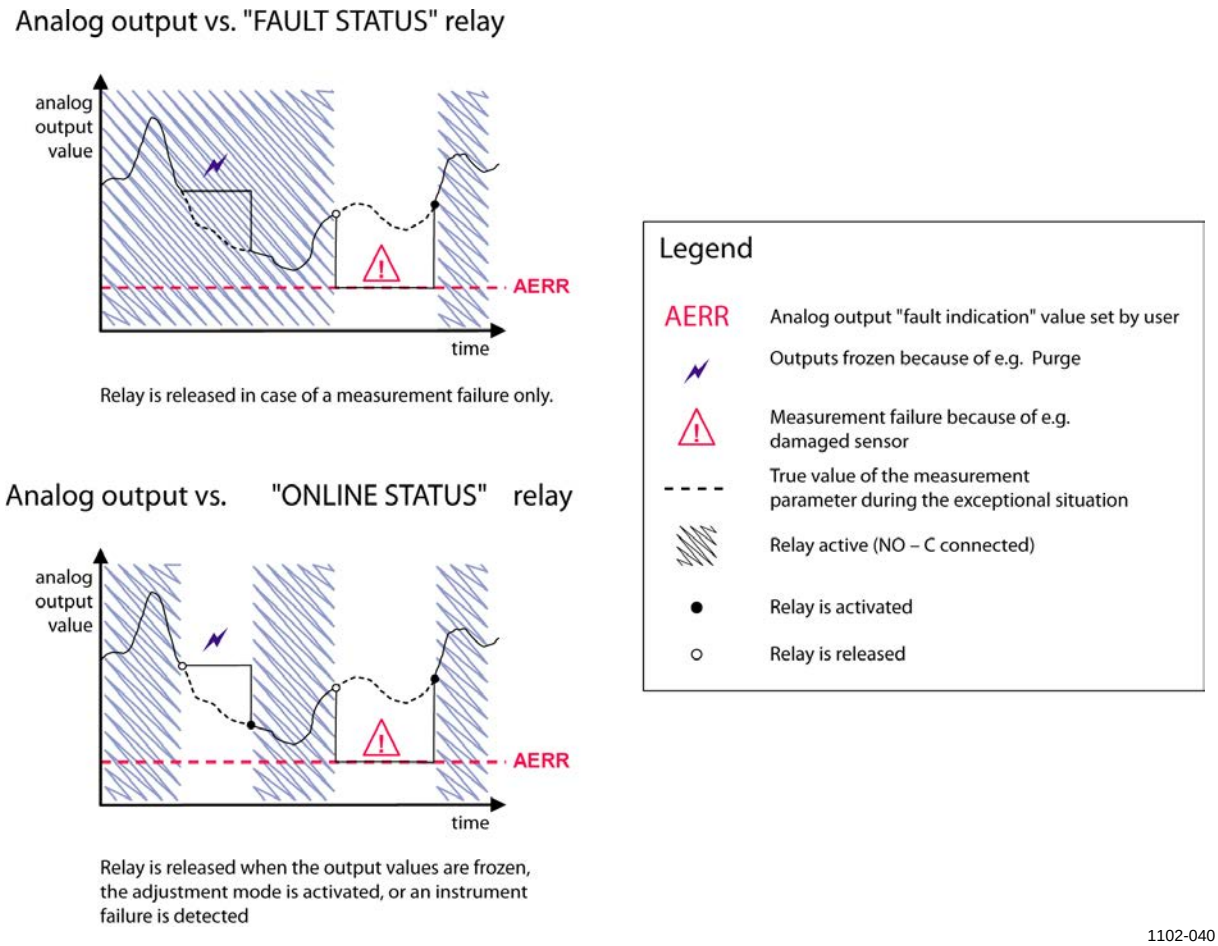
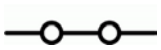
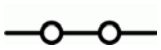
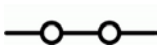
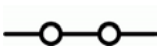
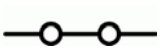
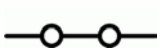
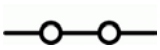
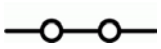
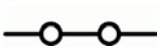
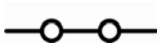

Analog output vs. "FAULT STATUS" relay
analog output value
AERR
time
Relay is released in case of a measurement failure only.
Analog output vs. "ONLINE STATUS" relay
analog output value
AERR
time
Relay is released when the output values are frozen, the adjustment mode is activated, or an instrument failure is detected
Legend
AERR
Analog output "fault indication" value set by user
Outputs frozen because of e.g. Purge
Measurement failure because of e.g. damaged sensor
True value of the measurement parameter during the exceptional situation
Relay active (NO – C connected)
Relay is activated
Relay is released
1102-040

Figure 62 FAULT/ONLINE STATUS Relay Output Modes

FAULT/ONLINE STATUS relays are usually used in conjunction with an analog output to obtain validity information for the output value.

NOTE	If transmitter loses its power, all status-based relays are released similarly to the case of an instrument failure.

Table 31 Relay State Examples

Criterion for Relay Activation	Transmitter Operation Status	NC-C Connected	NO-C Connected
Not chosen			
	Power off		
$T_{d/f}$ below -10 °C*	Measured $T_{d/f}$ above -10 °C		
	Measured $T_{d/f}$ below -10 °C		
$T_{d/f}$ above -10 °C *	Measured $T_{d/f}$ above -10 °C		
	Measured $T_{d/f}$ below -10 °C		
Fault status	Measurement OK		
	Error active		
Online status	Measurement live		
	Purge, AutoCal, or sensor warming active		

* Hysteresis has an effect when relay switching is based on live measurement. See section Hysteresis on page 125.

Enabling/Disabling Relays

You can deactivate the relay outputs for example for service purposes of your system.

Indication Led Operation

Relay is activated: LED is lit
Relay is not activated: LED is not lit

Setting Relay Outputs

NOTE

When you have only one relay module installed, its relays are called “relay 1” and “relay 2”.

When you have two relay modules, the relays of the module connected to slot **MODULE 1** are called “relay 1” and “relay 2” and relays connected to slot **MODULE 2** are called “relay 3” and “relay 4”.

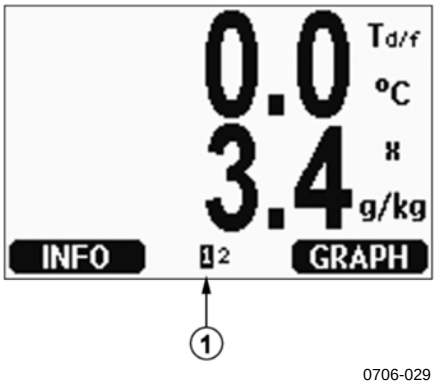


Figure 63 Relay Availability

Arrow in Figure 63 above shows where enabled relays are listed on the display. Activation state shown in black. Disabled relays are not shown.

Use the display/keypad to set the relay outputs.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Interfaces**, confirm by pressing the ►arrow button.
3. Select **Relay outputs**, confirm by pressing the ►arrow button.
4. Select **Relay 1/2/3/4**, confirm by pressing the ►arrow button.
5. Select the **Quantity**, confirm by pressing **Change**. Select the Quantity by using the arrow buttons. Confirm your selection by pressing **Select**. (Press **Fault Status** when the relay follows the transmitter error.) Press **Change** to set the value.
6. Select **Act. above / Act**. below. Press **SET** to confirm your selection. If asked, select **MODIFY** if you want to set the setpoint by using the arrow buttons. Select **REMOVE** if you want to remove the setpoint.
7. Select **Hysteresis**. Press **SET**. Set the hysteresis by using the arrow buttons. Press **OK**.
8. Select **Relay enable**, press **ON/OFF** to enable/disable the relay.

RSEL

Use the serial line to select the quantity, setpoints and hysteresis or enable/disable the relay outputs. Issue the **RSEL** command.

RSEL [*q1 q2 q3 q4*]<cr>

where

q1 = Quantity for the relay 1 or Fault/Online
q2 = Quantity for the relay 2 or Fault/Online
q3 = Quantity for the relay 3 or Fault/Online
q4 = Quantity for the relay 4 or Fault/Online

Factory setting: All relays disabled.

Use the quantity abbreviations presented above. See Table 5 on page 20.

Example of window limit switch: Selecting relay 1 to follow dewpoint measurement and relay 2 to follow sensor temperature measurement. Two relay setpoints are set for both relays.

```
>rsel tdf ts
Rel1 Tdf  above: 70.00 'C ? 50
Rel1 Tdf  below: - ? 30
Rel1 Tdf  hyst : 2.00 'C ? 2
Rel1 Tdf  enabl: ON ? on
Rel2 Ts   above: 140.00 'C ? 140
Rel2 Ts   below: - ? 80
Rel2 Ts   hyst : 2.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Example of normal limit switch: Selecting relay 1 to follow sensor saturation rate and relay 2 to follow sensor temperature. One setpoint is chosen for all the outputs.

```
>rsel ssr ts
Rel1 SSR  above: 50.00 % ? 70
Rel1 SSR  below: - ? -
Rel1 SSR  hyst : 2.00 % ? 2
Rel1 SSR  enabl: ON ? on
Rel2 Ts   above: 80.00 'C ? 140
Rel2 Ts   below: 60.00 'C ? -
Rel2 Ts   hyst : 1.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Example of using relay 1 as fault alarm: Selecting relay 1 to follow the fault status and relay 2 to follow the temperature measurement.

```
>rsel fault ts
Rel1 FAUL above: -
Rel1 FAUL below: -
Rel1 FAUL hyst : -
Rel1 FAUL enabl: ON ? on
Rel2 Ts   above: 140.00 'C ? 140
Rel2 Ts   below: 80.00 'C ? 80
Rel2 Ts   hyst : 2.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Testing Operation of Relays

Testing activates relays even if they are disabled.

Use the module push buttons to activate the relays. Press the **REL 1** or **REL 2** button to activate the corresponding relay.

Use the display/keydpad to test the operation of relays.

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **System**, press the ► arrow button.
3. Select **Diagnostics**, press the ► arrow button.
4. Select **Relay tests**, press the ► arrow button.
5. Select **Invert relay 1 ...** , press **TEST**. Now the selected relay output is forced to opposite state. Press **OK** to return to normal operation.
6. Press **EXIT** to return to the basic display.

RTEST

Use the serial line command **RTEST** [ON/OFF ON/OFF] to test the operation of the relays.

Example: Testing all four relays.

```
>rtest on on on on
 ON ON ON ON
>
>rtest off off off off
 OFF OFF OFF OFF
```

Issue the command **RTEST** to stop testing.

Sensor Functions

AutoCal

To obtain the best possible accuracy in measurements taken in dry environments, DMT345 and DMT346 have a built-in AutoCal feature. During the AutoCal, the transmitter adjusts the dry-end reading to correspond to the calibrated values. This is a unique and patented method to avoid errors in accuracy when monitoring low dewpoints.

The AutoCal is carried out if the following criteria for the measurement environment are fulfilled:

- Relative humidity must be <10 %.
- Temperature must be 0<T<140 ºC.
- Humidity environment must be stable. The maximum change in the dewpoint can be 2 ºC in 15 seconds.

NOTE	AutoCal cannot operate if the above conditions are not fulfilled.

If the adjustment in the AutoCal reaches a preset maximum value or if the AutoCal correction fails, for example, because of unstable conditions, a new AutoCal will take place later (if the automatic AutoCal is turned on).

Automatic AutoCal

As a default, the automatic AutoCal in DMT345 and DMT346 is turned on. In this mode, the calibration takes place automatically if the dewpoint or temperature changes significantly, typically more than 10 ºC. However, if there are no changes in the conditions, the AutoCal will take place repeatedly after one hour from the last AutoCal.

Manual AutoCal

To ensure that AutoCal has taken place for obtaining the most accurate measurement in a very dry environment, you can perform Autocal manually before measuring as follows:

1. Open the **Main Menu** by pressing any of the ▲▼◄► arrow buttons.
2. Select **Measuring**, press the ► arrow button.
3. Select **Manual AutoCal**, press the ► arrow button.

4. Press **START** to start AutoCal. If the AutoCal conditions are not fulfilled, a note appears on the display informing that the calibration cannot be made.

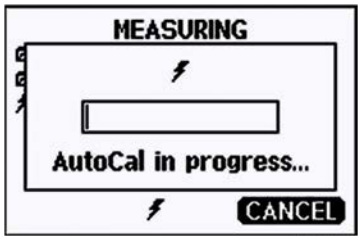


Figure 64 Following AutoCal on the Display

5. Press **EXIT** to return to the basic display.

You can also activate Manual AutoCal by pressing both **AUTOCAL** buttons on the transmitter motherboard. These are the same buttons as the pressure set buttons, but when pressed simultaneously, they will start the AutoCal procedure. See Figure 58 on page 101 for location of the **AUTOCAL**/pressure set buttons.

If the AutoCal conditions are not fulfilled, a note appears on the display informing that the calibration cannot be made.

Sensor Purge

Sensor Purge is available for DMT345 and DMT346. The Purge should be carried out to achieve the shortest response times and the best long-term stability.

Sensor Purge is an automatic procedure, in which the sensor is dried. Thus, the sensor will respond very fast when installing the probe from an ambient to a dry gas. Sensor Purge also corrects the possible gain drift caused by some chemicals, thus ensuring together with AutoCal the best measurement accuracy and long-term stability.

As a default, the interval Purge and power-up Purge are turned on automatically in DMT345 and DMT346. It is recommended not to turn them off. The automatic sensor Purge can also be started manually. If enabled, power-up Purge will start always about 10 seconds after reset. If the power is continuously turned on in the transmitter, the automatic sensor Purge will be performed at an interval of 24 hours.

A sensor purge should be performed always before calibration (see the calibration instructions) or when there is a reason to believe that a sensor has become exposed to an interfering chemical.

Starting and Configuring Sensor Purge

Using Display/Keypad (Optional)

1. Open the **Main Menu** by pressing any of the ▼▲◄► arrow buttons.
2. Select ►**Measuring**, press ►button**.**
3. Select ►**Purge**, press ► button.

Figure 65 Sensor Purge Settings

- Start the sensor purge manually by selecting **Start purge now** and pressing START.
- Select **Purge on power-up** by using the arrow buttons. Press On/Off to turn the start-up purge on/off.
- Set the automatic purge interval by selecting **Interval: ...**, press **SET.** Set the purge interval and the unit (minutes/hours) by using the arrow buttons. The interval must be 10 min … 48 h. Press **OK.**
- If you have the data logger module installed, you can also specify the **Date** and **Time** when the purge is performed next.

4. Press **EXIT** to return to the basic display.

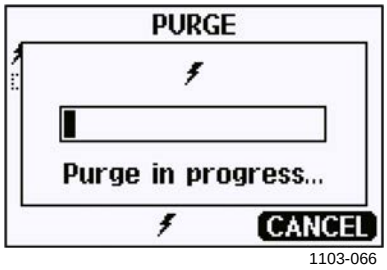


Figure 66 Performing Sensor Purge

Using Serial Line

PURGE

Use the **PURGE** command to start the sensor purge immediately.

PURGE<cr>

Example:

```
>purge
Purge started, press any key to abort.
>
```

The prompt '>' appears when the heating period is over. However, the transmitter outputs are locked to the values measured before performing sensor purge until the settling time is over.

PUR

With **PUR** command you can enable or disable automatic and power-up sensor purge and set the interval for automatic purge. The default purge interval is 24 hours. If the sensor is exposed to chemicals it is recommended to have the sensor purge done at least once in 720 min (=12 hours). In applications where the chemical exposure is not likely, the interval can be longer.

PUR<cr>

If the transmitter has a data logger module installed, you can also set the starting date and time for the interval purge. After the set time has been reached, the interval purge will be performed at the set interval. This functionality can be used to make sure the sensor purge starts at a specific time of the day.

Do not change the settings for duration, settling, temperature, temperature difference, or purge triggering unless instructed by Vaisala personnel.

Type **PUR** and press ENTER to proceed. Skip unchanged values by pressing ENTER. Input changed values in the format shown by the current value (for example, date and time). The maximum interval is 14400 minutes (=10 days).

Example (no data logger module installed):

```
>pur
Interval Purge : ON ?
Interval       : 1440 min ?
Power-up Purge : ON ?
Duration       : 60 s ?
Settling       : 240 s ?
Temperature    : 180 'C ?
Temp. diff.    : 0.5 'C ?
Trigger Purge  : OFF ?
RH trigger     : 20 %RH ?
>
```

Example (with data logger module installed):

```
>pur
Interval Purge : ON ?
Interval       : 1440 min ?
Next Purge date: 2011-03-31 ?
Next Purge time: 12:00:00 ?
Power-up Purge : ON ?
Duration       : 60 s ?
Settling       : 240 s ?
Temperature    : 180 'C ?
Temp. diff.    : 0.5 'C ?
Trigger Purge  : OFF ?
RH trigger     : 20 %RH ?
>
```

NOTE To activate the new interval settings immediately, reset the transmitter.

NOTE When sensor purge in power-up is enabled, wait about 6 min after power up before taking measurements. The output channels are locked for the first operation minutes to the initial measured values

Sensor Warming

DMT345 and DMT346 contain a sensor warming function, that is, when humidity reaches a set limit (default: 80%RH), sensor warming operation is activated automatically. Sensor warming continues as long as the humidity is above that limit.

When the warming starts, the sensor operation indicator is displayed on the optional display and relays configured as "online status" (if any) will be released. Warming does not affect $T_{d/f}$,$T_{d/f\ atm,}$ T_d,$T_{d\ atm,}$ x, H_2O and P_w quantities, all others will be frozen.

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CHAPTER 5
MODBUS

This chapter contains information that is needed when operating the transmitter using the Modbus protocol.

Overview of Modbus Protocol Support

The DMT345/346 transmitters can be accessed using the Modbus serial communication protocol. Support for Modbus protocol is available on all DMT345/346 transmitters as a standard feature from software version 5.10 onward. The supported Modbus variants and the connections they use are listed in Table 32 below.

Table 32 Supported Modbus Variants

Supported Modbus Variant	Connections
Modbus RTU (Serial Modbus)	RS-232 (standard User Port) RS-422/485 interface (optional module)
Modbus TCP (Ethernet Modbus)	LAN interface (optional module) WLAN interface (optional module)

The supported Modbus functions, registers, configuration options, and diagnostics are described in Appendix C, Modbus Reference, on page 177.

Note the following limitations of the Modbus implementation:

- Modbus TCP mode accepts only one TCP connection at a time. Design the system so that only one Modbus TCP client accesses the transmitter.
- Modbus TCP can process reliably only one Modbus transaction at a time. Reduce the polling rate of the client to avoid nested transactions.

Taking Modbus into Use

To take the Modbus protocol into use on the transmitter, you must perform some configuration tasks using the built-in display and keypad (optional) or a PC connected to the serial line. For example, you can connect to the service port using the USB service cable (Vaisala order code: 219685). The transmitter must be powered from a suitable power supply during configuration.

Instructions for performing the configuration are provided in the following sections:

- Enabling Serial Modbus on page 139
- Enabling Ethernet Modbus on page 140

After configuring the transmitter, perform the transmitter installation and wiring according to the instructions in Chapter 3, Installation, on page 25.

The configuration instructions assume you are familiar with the use of the transmitter. Additional details on the display/keypad, service port use, and serial commands are available in other sections of this manual:

- The use of the display/keypad option is described in section Display/Keypad on page 64.
- If this is the first time you are using the USB service cable, you can find detailed instructions in section Service Port Connection on page 78. You must install the required driver before using the service cable.
- Configuration of the LAN and WLAN interfaces is decribed in section LAN Communication on page 80.
- The serial commands available through the service port are described beginning from section List of Serial Commands on page 90.

Enabling Serial Modbus

In addition to enabling the Modbus protocol in the device, Modbus over RS-232 or RS-485 needs the following software settings: serial bit rate, parity, number of stop bits, and Modbus device address.

Using Display/Keypad (Optional)

1. Open the **Main Menu** by pressing any of the ▼▲◄► arrow buttons.
2. Navigate to **Interfaces ► Serial Interface**.
3. On the **Serial Interface** settings screen:
   - Enable the Modbus protocol.
   - Change the baud rate and parity if necessary.
   - Set the Modbus device address.

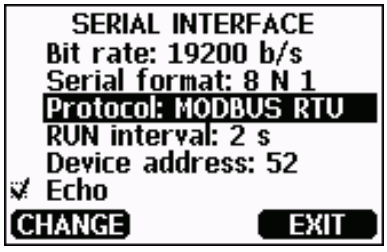

Figure 67 Serial Interface Settings

4. After changing the settings, press the **EXIT** button. The Modbus configuration is now complete, as configuration changes made with the display and keypad are effective immediately.

Using Serial Line

1. Open the transmitter cover.
2. Connect power supply wiring (if not using the power supply module) and power up the transmitter.
3. Connect the USB service cable between a computer and the service port of the transmitter.
4. Start the Vaisala USB Instrument Finder program (which has been installed on the computer along with the USB service cable driver), and check the COM port that the cable is using.
5. Open a terminal program, and connect to the service port. The fixed serial line settings of the service port are 19200, 8, 1, N.

6. Use the **SMODE** command to enable the Modbus mode:

```
>smode modbus
Serial mode    : MODBUS
>
```

7. If necessary, use the **SERI** command to check and/or change the serial interface settings for the User Port. For example, to set the User Port serial settings to 19200 N 8 1, issue the following command:

```
>seri 19200 N 8 1
```

NOTE	The number of data bits must always be 8 for Modbus RTU. Serial Modbus interface of the transmitter does not work with baud rates 115, 150, and 300 b/s.

8. Use the **ADDR** command to set the Modbus address of the transmitter. For example, to set the Modbus address to 52, issue the following command:

```
>addr 52
```

   You must set a non-zero address or Modbus RTU will not work.

9. The Modbus configuration is now complete. Reset or power cycle the transmitter to enable the Modbus mode, and proceed with the installation of the transmitter and the wiring of the serial interface.

Enabling Ethernet Modbus

In addition to enabling the Modbus protocol in the device, Modbus TCP needs the following software settings: IP address, subnet mask, and default gateway address. Also network name (SSID) and security settings must be configured if wireless network is used.

Using Display/Keypad (Optional)

1. Open the **Main Menu** by pressing any of the ▼▲◄► arrow buttons.
2. Navigate to **Interfaces ► Network Settings ► IP Configuration**.
3. On the **IP Configuration** screen, set the network configuration settings, and exit to save the changes.

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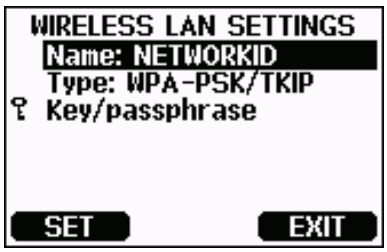
Figure 68 IP Configuration

4. Navigate back to the **Network Settings** menu. If you are using the WLAN interface, select **Wireless LAN Settings**.
5. On the **Wireless LAN Settings** screen, set the network name (SSID) and security options, and exit to save the changes.

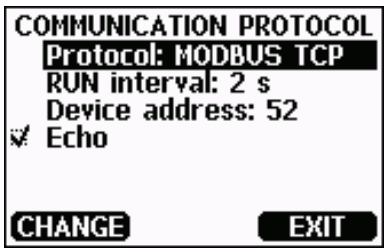


1101-036

Figure 69 Wireless LAN Settings

6. Navigate back to the **Network Settings** menu. Select **Communication Protocol**.
7. On the **Communication Protocol** screen, enable the Modbus protocol. Press the **EXIT** button to save the changes.

   Note that the device address setting is not relevant for Modbus TCP. In the Modbus mode, the transmitter will respond to all valid Modbus messages with any “unit identifier” value.



1101-034

Figure 70 Communication Protocol

8. The Modbus configuration is now complete, as configuration changes made with the display and keypad are effective immediately.

Using Serial Line

1. Open the transmitter cover.
2. Connect power supply wiring (if not using the power supply module) and power up the transmitter.
3. Connect the USB service cable between a computer and the service port of the transmitter.
4. Start the Vaisala USB Instrument Finder program (which has been installed on the computer along with the USB service cable driver), and check the COM port that the cable is using.
5. Open a terminal program, and connect to the service port. The fixed serial line settings of the service port are 19200, 8, 1, N.
6. Use the **SMODE** command to enable the Modbus mode:

```
>smode modbus
serial mode    : MODBUS>
```

7. Configure the networking parameters of the interface you are using:

NOTE	After transmitter startup, it may take a few minutes for the network interface to become available for configuration.

a. Use the **NET** command to configure the networking parameters of both LAN and WLAN interface. You can, for example, enter the command without parameters and enter the settings as prompted:

```
>net
DHCP           : ON ? OFF
IP address     : 0.0.0.0 ? 143.154.142.102
Subnet mask    : 0.0.0.0 ? 255.255.0.0
Default gateway: 0.0.0.0 ?
Web config.    : ON ? OFF
Save changes (Y/N) ? y
OK
```

b. If you are using the WLAN interface, use the **WLAN** command to configure the network name (SSID) and security settings. For example:

```
>wlan
Network SSID   : NAME ? NETWORKID
Type           : OPEN ? WPA-PSK/TKIP
WPA-PSK phrase ? thequickbrownfox
Save changes (Y/N) ? y
OK
```

For a description of the available settings, see section Wireless LAN Configuration on page 83.

8. Modbus configuration is now complete. Reset or power cycle the transmitter to enable the Modbus mode, and proceed with the installation of the transmitter.

Diagnostic Modbus Counters

DMT345/346 has diagnostic counters that can be used to pinpoint Modbus problems. The counters are always active when the Modbus protocol is enabled.

Viewing Counters Using Display/Keypad

You can use the display/keypad option to view and clear the counters. Enter the **Main Menu** and navigate to **System ► Diagnostics ► MODBUS Counters**.

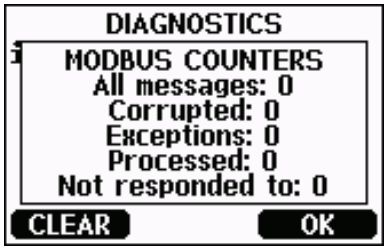


Figure 71 Modbus Counters

Viewing Counters Using Service Port

Use the **Modbus** command to view the counters:

MODBUS<cr>

Example:

```
>modbus
Bus messages   : 0
Bus comm. error: 0
Bus exceptions : 0
Slave messages : 0
Slave no resp. : 0
Last message   :
>
```

In addition to the diagnostic counters, the last message (received or transmitted) is shown in hexadecimal format. If the last message was a broadcast message, the suppressed response message is shown.

The last message displayed may be incomplete if there is active Modbus traffic while using the **MODBUS** command.

Modbus RTU only: If the last received message was rejected because of bad CRC checksum, the **MODBUS** command displays the message with corrected CRC (last two bytes updated).

To clear the counters, select again the Modbus mode with the **SMODE** command:

```
>smode modbus
```

Disabling Modbus

If you stop using Modbus with the transmitter, set the transmitter to some other operating mode using the display/keypad option or the **SMODE** command.

For example, to return the transmitter to the RUN mode where the measurements are output at regular intervals, issue the following command through the service port:

```
>smode run
```

Alternatively, you can enter the **Main Menu** using the display/keypad option, and change the mode from the **Interfaces** submenu.

The other communication settings of the output interface (User Port, LAN interface, or WLAN interface) will remain as configured, but the Modbus protocol will be disabled.

CHAPTER 6

MAINTENANCE

This chapter provides information that is needed in basic maintenance of the product. Possible error states and situations, their probable causes and remedies are described in this chapter. This chapter also contains contact information for Vaisala Technical Support.

Periodic Maintenance

Cleaning

Clean the transmitter enclosure with a soft, lint-free cloth moistened with mild detergent.

Changing the Cooling Set Filter

NOTE	Some probe and filter combinations are equipped with a washer under the filter. The purpose of the washer is to prevent vibration from loosening the filter. If the washer is present, leave it in place when changing the filter.

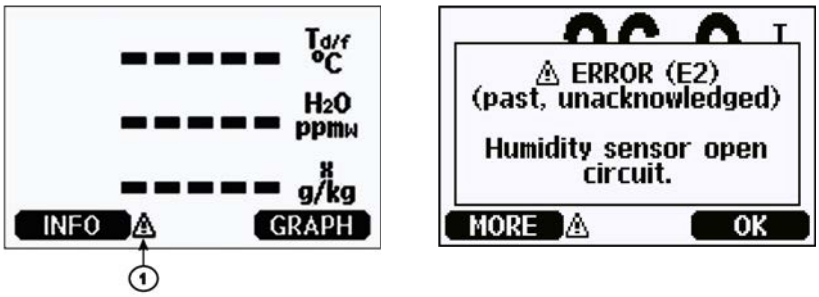
1. Turn the filter counter-clockwise to remove it.
2. Install a new filter on the cooling set and tighten it.

New filters can be ordered from Vaisala, see section Spare Parts and Accessories on page 168.

Error States

In error state the affected quantities are not measured and the output is shown as follows:

- Analog channel outputs 0 mA or 0 V (you can use the serial line command **AERR** or display/keypad to change this fault indication value, see section Analog Output Fault Indication Setting on page 122).
- Serial port outputs stars "***" instead of measurement data.
- Display shows "----" instead of measurement data.
- Cover LED is blinking.
- Error indicator is shown on the display.



0706-017, 1103-069

Figure 72 Error Indicator and Error Message

Number refers to Figure 72 above:

1 = Error indicator

The error indicator disappears when the error state is over and you have checked the error message. Press the **INFO** button to display the error message.

You can also check the error message via the serial interface by using the command **ERRS**. In case of constant error, please contact Vaisala Technical Support.

Table 33 Error Messages

Error Code	Error Message	Action
E0	Humidity sensor measurement malfunction.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
E1	Humidity sensor short circuit	
E2	Humidity sensor open circuit	Check the integrity of the humidity probe and the probe cable.
E3	Temperature sensor open circuit.	
E4	Temperature sensor short circuit.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
E5	Temperature measurement malfunction	
E6	Temperature sensor current leak.	
E7	Internal ADC read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E9	Checksum error in the internal configuration memory	
E10	Internal EEPROM read error	
E11	Internal EEPROM write error	
E12 … E13	Add-on module 1 (or 2) connection failure	Turn off the power and check the module connection. Turn on the power.
E14	Device internal temperature out of range	Ensure that the operating temperature is within the valid range.
E15	Internal RAM memory or software checksum error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E18	Internal ADC reference voltage out of range	
E19	Internal analog output reference voltage out of range	
E20 … 22	Configuration switches for analog output 1/2/3 set incorrectly	Check and re-set the switches, see page 57.
E24 … E25	Internal error in add-on module 1 (or 2)	Disconnect the power and check the module connection.
E26	Communication module installed in incorrect add-on module slot	Disconnect the power and change the communication module to another module slot.
E28 … E29	Unknown/incompatible module installed in add-on module slot 1 (or 2)	Ensure that the module is compatible with the DMT345/346.
E30	Internal analog voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
E31	Internal system voltage out of range	Check that the supply voltage is correct and the power supply can provide enough power for the instrument.

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question
- Serial number of the product
- Name and location of the installation site
- Name and contact information of a technically competent person who can provide further information on the problem

Product Returns

If the product must be returned for service, see www.vaisala.com/returns.

For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

CHAPTER 7

CALIBRATION AND ADJUSTMENT

This chapter provides you with instructions on how to calibrate and adjust Vaisala DRYCAP® Dewpoint Transmitters DMT345 and DMT346.

Calibration

DMT345 and DMT346 are fully calibrated and adjusted as shipped from the factory. The typical calibration interval is one year. Calibration must always be done when there is reason to believe that the device is not within the accuracy specifications.

It is recommended that the device should be sent to a Vaisala Service Center for calibration and adjustment. For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

NOTE	If the process is not shut down for removing the transmitter for calibration, the hole for the probe in the cooling set must be plugged; otherwise, there is a risk of water condensing inside the cooling pipe (in overpressurized processes).

User Calibration and Adjustment

When adjusting DMT345 or DMT346, the reading of the transmitter is changed to correspond to the reference value. After the adjustment, the original calibration certificate shipped with the product is no longer valid.

The following adjustments are possible:

- Two-point relative humidity adjustment
- One-point dewpoint adjustment
- One-point temperature adjustment
- Two-point temperature adjustment
- Analog output adjustment

Opening and Closing Adjustment Mode

Open the transmitter cover. The buttons needed in the adjustment are on the left-hand side of the motherboard, see Figure 2 on page 23.

Press the **ADJ** button to enable the adjustment mode. The indicator LED indicates the adjustment availability.

Table 34 Indicator Led Functions

Indicator Led Function	Description
LED off	adjustment locked
LED on	adjustment available
LED blinking evenly	measurement not stabilized
LED blinking with short pulses	performing Purge/AutoCal

Press the **ADJ** button again to disable the adjustment mode.

NOTE Fixed pressure compensation of 1013.25 hPa is used when in adjustment mode. Adjustments should be performed at ambient pressures.

Adjustment Information

Adjustment information is shown on the device information screens; see section Device Information on page 106. Use the display/keypad to feed the adjustment information.

1. If you are not in the adjustment menu, press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjustment info.**
3. Select **Date**, press **SET**. Enter the date by using the arrow buttons. Press **OK**.
4. Select **i**, press **SET**. Enter information text including 17 characters at maximum by using the arrow buttons. Press **OK**.
5. Press **EXIT** to return to the basic display.

CTEXT and CDATE

Use the serial line command **CTEXT** to enter text in to the adjustment information field. First press the adjustment button on the motherboard inside the transmitter.

Example:

```
>ctext
Adjust. info   : (not set) ? -60ºC
>
```

Use the **CDATE** command to input date to the adjustment information field. Set the adjustment date in format YYYY-MM-DD.

Example:

```
>cdate
Adjust. date   : (not set) ? 2004-05-21
>
```

Press the adjustment button on the motherboard inside the transmitter to disable the adjustment function.

Two-Point Relative Humidity Adjustment

Using Display/Keypad

NOTE	Reference humidities must be ~0 %RH and 30 ... 75 %RH. A suitable product for the two point RH calibration is for example the Vaisala Humidity Calibrator HMK15.

1. Press the **ADJ** button (see Figure 2 on page 23) to open the **ADJUSTMENT MENU**:
2. Select **Adjust T_d measurement**, press ► button.
3. Select **2-point RH adjustment**, press **START**. At this point, the device carries out the chemical purge.
4. Remove the filter from the probe and insert the probe in the dry end reference condition (~0 %RH). Press **OK**.

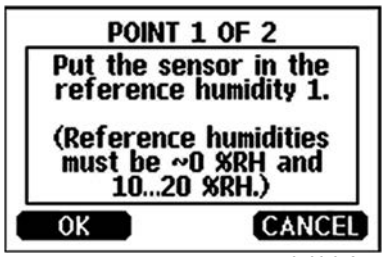


Figure 73 Inserting the Sensor in Reference Humidity 1

5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display. Press **EXIT** to return to the previous display.
6. Press **READY** when stabilized. Enter the reference value by using the arrow keys.

Figure 74 Waiting for Readings to Stabilize

Now proceed to the adjustment at the wet end reference condition (30 ... 75 %RH) and carry out the procedure as described in the previous items.

7. Press **YES** to confirm the adjustment. Press **OK** to return to the adjustment menu.
8. Before closing the adjustment mode, feed the adjustment information into the device, see section Adjustment Information on page 151. Press **EXIT** to close the adjustment mode and return to the basic display.

Using Serial Line

NOTE	Reference humidities must be ~0 %RH and 30 ... 75 %RH. A suitable product for the two point RH calibration is for example the Vaisala Humidity Calibrator HMK15.

1. Connect the DMT345/346 to a PC. See section Serial Line Communication on page 76. Open a terminal program.
2. Carry out the chemical purge.
3. Press the **ADJ** button.
4. Remove the filter from the probe and insert the probe in the dry end reference conditions (~0 %RH).
5. Issue the **FCRH** command and press **Enter**.

FCRH

6. Wait at least 30 minutes for the sensor to stabilize.
7. Press **Enter** a few times to check if the reading is stabilized.
8. When the reading is stabilized, give the reference humidity after the question mark and press **Enter**.

```
>fcrh

RH  :    11.25  Ref1 ?
RH  :    11.25  Ref1 ?
RH  :    11.25  Ref1 ?
RH  :    11.24  Ref1 ?
RH  :    11.24  Ref1 ? 11.3
Press any key when ready  ...
```

9. Now the device is waiting for the wet end reference. Insert the probe in the wet end reference condition (30 ... 75 %RH). Press any key when ready.
10. Let the probe stabilize for about 30 minutes. You can follow the stabilization by pressing **Enter**.

11. When stabilized, type the high end reference value after the question mark and press **Enter**.

```
>fcrh

RH  :    11.25  Ref1 ? c
RH  :    11.24  Ref1 ? c
RH  :    11.24  Ref1 ? 11.3
Press any key when ready  ...

RH  :    75.45  Ref2 ? c
RH  :    75.57  Ref2 ? c
RH  :    75.55  Ref2 ? c
RH  :    75.59  Ref2 ? 75.5
OK
>
```

12. The OK indicates that the adjustment has succeeded and the new calibration coefficients are calculated and stored. Enter the adjustment information (date and text) to the memory of the transmitter, see section Adjustment Information on page 151.
13. Press the **ADJ** button on the motherboard to close the adjustment mode.
14. Take the probe out of the reference conditions and replace the filter.

One-Point Dewpoint Adjustment

One-Point Dewpoint Adjustment Using Display/Keypad

NOTE	This is a highly critical adjustment, to be performed only in laboratory conditions. Preferably use the display/keypad interface to perform one-point dewpoint $T_{d/f}$ adjustment. Before proceeding with the Td/f adjustment you must perform the RH adjustment. For DMT345/346, the reference dewpoint must be below -25 °C (-13 °F) and temperature must be below 40 °C (104 °F).

NOTE	This adjustment is valid only if the measurement or process is in the lower end of the measurement range (in very dry). See Specifications on page 161.

When adjusting the dewpoint, refer to the following instructions:

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjust T_d measurement**.
3. Select by pressing **1-point T_d adjustment**. Press **START** to start adjusting.
4. Leave the sensor to stabilize for at least one (1) hour. Follow the instructions on the display.

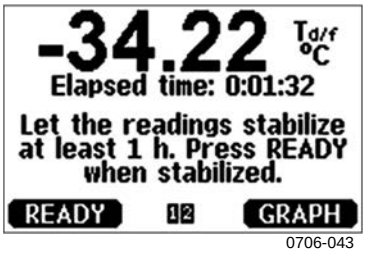


Figure 75 Following Stabilization

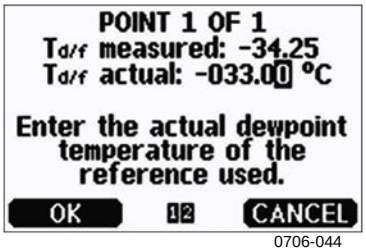
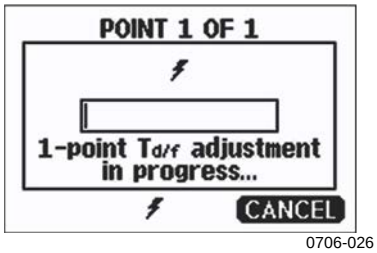


Figure 76 Proceeding with $T_{d/f}$ Adjustment

5. Enter the actual reference frostpoint temperature.
6. The transmitter performs $T_{d/f}$ adjustment. This may take up to six (6) minutes.



0706-026

Figure 77 Completing T $_{d/f}$ Adjustment

7. The adjustment is now completed.

NOTE	Several AutoCals can be necessary after this adjustment has been performed until the transmitter reaches full accuracy.

One-point Dewpoint Adjustment Using Serial Line

1. Let the sensor stabilize for at least one (1) hour.
2. Press the **ADJ** button on the motherboard to enable adjustments.
3. Use the **AØ1** command to perform the adjustment.

AØ1<cr>

Example:

```
>a01
Tf :   -34.25 'C  Ref ? -33
Wait for Purge data...OK
>
```

4. Press the **ADJ** button on the motherboard inside the transmitter to disable adjustments.

NOTE	Several AutoCals can be necessary after this adjustment has been performed until the transmitter reaches full accuracy.

Adjusting Temperature

NOTE	Temperature adjustment in process conditions is possible only with DMT345. Temperature adjustment of DMT346 cannot be performed in process conditions as the DMT346 measures a cooled temperature whereas the reference instrument measures the actual process temperature.

Adjusting Temperature Using Display/Keypad

Use preferably the display/keypad to adjust the temperature.

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjust T measurement**.
3. Select by pressing **1-point or 2-point adjustment**. Press **START** to start adjusting.
4. Remove the filter from the probe and insert the probe into a reference temperature.
5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.
6. Press **READY** when stabilized. Enter the reference temperature using the arrow buttons.

   When carrying out the two-point adjustment proceed to the next adjustment point and carry out the procedure as described in the previous steps. Note that the difference between the two temperature references must be at least 30 ºC.
7. Press **OK**. Press **YES** to confirm the adjustment.
8. Press **OK** to return to the adjustment menu.
9. Press **EXIT** to return to the basic display.

Adjusting Temperature Using Serial Line

CT

Use the serial line command **CT** to adjust the temperature.

1. Press the **ADJ** button on the motherboard to open the adjustment mode.
2. Remove the probe filter and insert the probe into the reference temperature.
3. Type **CT** and press Enter. Type **C** and press Enter to check if the reading is stabilized.
4. Let the reading stabilize, enter the reference temperature after the question mark and press Enter three times.

   When having another reference temperature (two-point adjustment) press Enter twice and insert the probe to the second reference. When the reading is stabilized, enter the second reference temperature after the question mark and press Enter. Note that the difference between the two temperature references must be at least 30 ºC.

   Example (1-point adjustment):

```
>ct
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? 16.0
Press any key when ready  ...
T   :    16.06  Ref2 ?
OK
>
```

   OK indicates that the calibration has succeeded.

5. Press the **ADJ** button on the motherboard to close the adjustment mode.
6. Take the probe out of the reference conditions and replace the filter.

Adjusting Analog Outputs

In the analog output calibration the analog output is forced to the following values:

Current output	=	2 mA and 18 mA
Voltage output	=	10 % and 90 % of the range

Connect the transmitter to a calibrated current/voltage meter in order to measure either current or voltage depending on the selected output type. Use the display/keypad or the serial line to do this.

Adjusting Analog Outputs Using Display/Keypad

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjust analog outputs**.
3. Select the output to be adjusted **Adjust analog output 1/2**, press **START**.
4. Measure the first analog output value with a multimeter. Enter the measured value by using the arrow buttons. Press **OK**.
5. Measure the second analog output value with a multimeter. Enter the measured value by using the arrow buttons. Press **OK**.
6. Press **OK** to return to the adjustment menu.
7. Press **EXIT** to close the adjustment and to return to the basic display.

Adjusting Analog Outputs Using Serial Line

ACAL

Use the serial line to perform the analog output adjustment. Use the **ACAL** command and enter the multimeter reading.

Example (current outputs):

```
>acal
Ch1    I1   (mA) ?    2.046
Ch1    I2   (mA) ?    18.087
Ch2    I1   (mA) ?    2.036
Ch2    I2   (mA) ?    18.071
>
```

Press the adjustment button on the motherboard inside the transmitter again to disable the adjustment function.

CHAPTER 8

TECHNICAL DATA

This chapter provides the technical data of the product.

Specifications

Performance

Table 35 Dewpoint Specifications DMT345

Property	Value
Sensor	Vaisala DRYCAP®180S
Measurement range	-40 ... +100 °C (-40 ... +212 °F) T_d
Accuracy	±2 °C (±3.6 °F) T_d
	See accuracy graph in Figure 78 on page 161.
Response time 63% [90%] flow rate 1l/min and 1 bar pressure from dry to wet from wet to dry including auto-calibration	 5s [10 s] 45s [5 min]

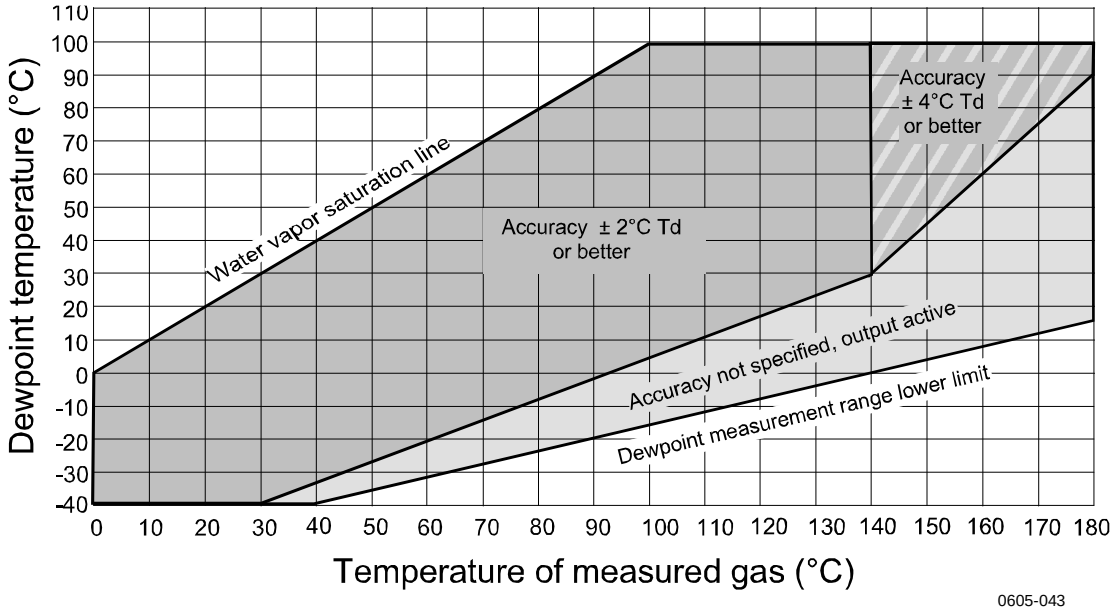

Dewpoint temperature (°C)
Temperature of measured gas (°C)
Water vapor saturation line
Accuracy ± 2°C Td or better
Accuracy ± 4°C Td or better
Accuracy not specified, output active
Dewpoint measurement range lower limit
0605-043

Figure 78 Dewpoint Measurement Accuracy Graph DMT345

Table 36 Temperature Specifications DMT345

Property	Value
Measurement range with sensor warming	0 ... +180 °C (+32 ... +356 °F) upper range limited by humidity (at 80 %RH warming is switched on and T reading not actual process temperature)
Accuracy	±0.4 °C at 100 °C
Temperature sensor	Pt 100 IEC 751 1/3 class B

Table 37 Relative Humidity Specifications DMT345

Property	Value
Measurement range with sensor warming	0 ... 100 %RH 0 ... 80 %RH
Accuracy below 10 %RH above 10 %RH	 ±10 % of reading ±1.5 %RH + 1.5 % of reading

Table 38 Mixing Ratio Specifications DMT345

Property	Value
Measurement range (typical)	0 ... 1000 g/kg (0..7000 gr/lbs)
Accuracy	±12 % of reading

Table 39 Dewpoint Specifications DMT346

Property	Value
Sensor	Vaisala DRYCAP®180S
Measurement range	-25 … +100 °C (-13 … +212 °F) T_d
Accuracy	±2 °C (±3.6 °F) T_d See the accuracy graph in Figure 79 on page 163
Response time 63% [90%] flow rate 1l/min and 1 bar pressure from dry to wet from wet to dry including auto-calibration	 5s [10 s] 45s [5 min]

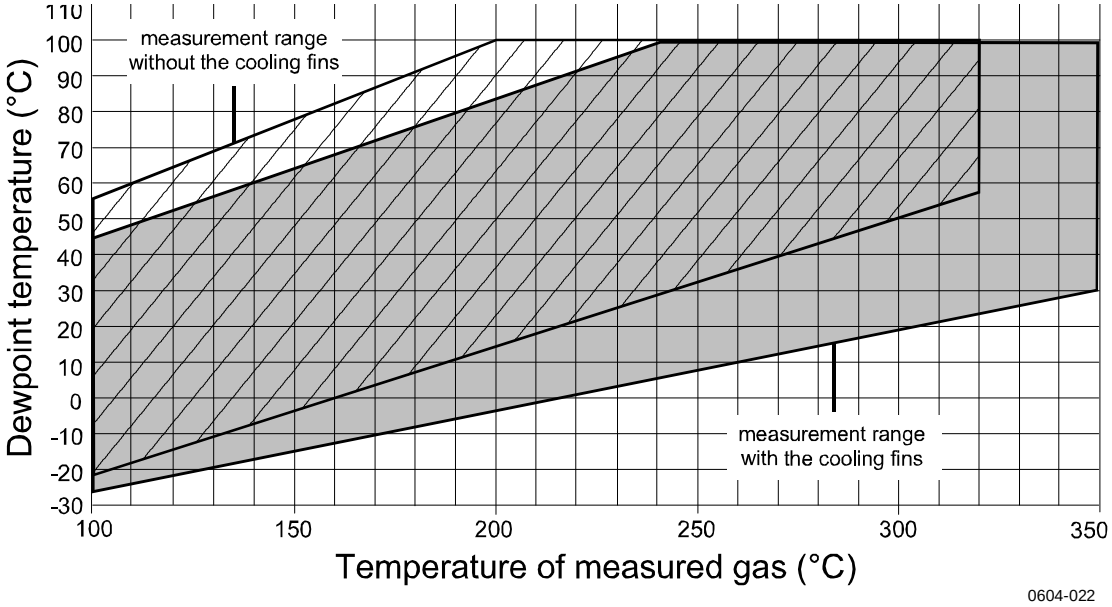


Figure 79 Dewpoint Measurement Accuracy Graph DMT346

Table 40 Mixing Ratio Specifications DMT346

Property	Value
Measurement range (typical)	0 ... 1000 g/kg (0 … 7000 gr/lbs)
Accuracy	±12 % of reading

Table 41 Operating Environment Specifications (Both Models)

Property	Value
Mechanical durability probes for transmitter body with display	 Up to +180 °C (+356 °F) for DMT345 Up to +350 °C (+662 °F) for DMT346 -40 ... +60 °C (-40 ... +140 °F) 0 ... +60 °C (32 … +140 °F)
Storage temperature range without display with display	 -55 … +80 °C (-67 … +176 °F) -40 … +80 °C (-40 … +176 °F)
Pressure range for probes	Slight pressure difference (~ 200 mbar)
Measured gases	Non-corrosive gases
Electromagnetic compatibility	EN61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations

Table 42 Inputs and Outputs Specifications (Both Models)

Property	Value
Operating voltage with optional power supply module	10 ... 35 VDC, 24 VAC 100 ... 240 VAC 50/60 Hz
Default start-up time initial reading after power-up full operation after sensor Purge and AutoCal	 3 s Approximately 6 min
Power consumption at 20 °C (U_{in} 24 VDC) U_{out} 2 × 0 ... 1V / 0 ... 5V / 0 ... 10V I_{out} 2 × 0 ... 20 mA RS-232 Display and backlight During sensor purge and warming	 Max 25 mA Max 60 mA Max 25 mA + 20 mA + 110 mA max
Analog outputs (2 standard, 3rd optional) Current output Voltage output	 0 ... 20 mA, 4 ... 20 mA 0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Accuracy of analog outputs at 20 °C	± 0.05 % full scale
Temperature dependence of the analog outputs	± 0.005 %/°C full scale
External loads Current outputs 0 ... 1V output 0 ... 5V and 0 ... 10V outputs	 R_L < 500 Ω R_L > 2 k Ω R_L > 10 k Ω
Wire size	0.5 ... 2.5 mm^2 (AWG 20 ... 14) stranded wires recommended
Digital outputs	RS-232 RS-422/485 (optional) LAN (optional) WLAN (optional)
Protocols	ASCII commands Modbus RTU Modbus TCP
Relay outputs (optional)	0.5 A, 250 VAC, SPDT
Display (optional)	LCD with backlight, graphic trend display
Menu languages	Chinese, English, Finnish, French, German, Japanese, Russian, Spanish, Swedish

Table 43 Mechanics Specifications (Both Models)

Property	Value
Cable bushing	M20×1.5, for cable diameter 8 ... 11 mm / 0.31 ... 0.43"
Conduit fitting	1/2" NPT
User cable connector (optional) Option 1 Option 2	 M12 series 8-pin (male) With plug (female) with 5 m / 16.4 ft black cable
Probe cable diameter	5.5 mm
Probe tube material	AISI 316L
Housing material	G-AlSi 10 Mg (DIN 1725)
Housing classification Without display With display and keypad	 IP 66 (NEMA 4X) IP 65 (NEMA 4X)
Transmitter weight (with probe, cable, and modules)	1.0 ... 3.0 kg (2.2 ... 6.6 lb)

Table 44 Standard Probe Cable Lengths and Approximate Transmitter Weight (in kg/lb)

Probe Type	Probe Cable Length			
	2 m	5 m	10 m	15 m
DMT345	1.3/2.9	1.4/3.1	1.7/3.7	2.2/4.8
DMT346	1.4/3.1	1.5/3.3	1.8/4.0	-

Technical Specifications of Optional Modules

Power Supply Module

Operating voltage	100 ... 240 VAC 50/60 Hz
Connections	screw terminals for 0.5 ... 2.5 mm^2 wire (AWG 20 ... 14)
Bushing	for 8 ... 11 mm diameter cable
Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-40 ... +70 °C (-40 ... +158 °F)
UL file number	E249387

Analog Output Module

Outputs	0 ... 20 mA, 4 ... 20 mA, 0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Operating temperature range	-40 ... +60 °C (-40 ... +140 ºF)
Power consumption	
U_{out} 0 ... 1 V	max 30 mA
U_{out} 0 ... 5V/0 ... 10V	max 30 mA
I_{out} 0 ... 20 mA	max 60 mA
External loads	
current outputs	R_L< 500 ohms
Max load + cable loop resistance	540 ohms
0 ... .1 V	R_L> 2000 ohms
0 ... 5 V and 0 ... 10 V	R_L> 10 000 ohms
Storage temperature range	-55 ... +80 °C (-67 ... +176 ºF)
3-pole screw terminal	
max wire size	1.5 mm^2 (AWG16)

Relay Module

Operating temperature range	-40 ... +60 ºC (-40 ... +140 ºF)
Operating pressure range	500 ... 1300 mmHg
Power consumption at 24 V	max 30 mA
Contacts SPDT (change over), for example,	
Contact arrangement Form C	
Imax	0.5 A 250 VAC
Imax	0.5 A 30 VDC
Safety standard for the relay component	IEC60950 UL1950
Storage temperature range	-55 ... +80 ºC (-67 ... +176 ºF)
3-pole screw terminal / relay	
max wire size	2.5 mm^2 (AWG14)

RS-485 Module

Operating temperature range	-40 ... +60 ºC (-40 ... +140 ºF)
Operating modes	2-wire (1-pair) half duplex 4-wire (2-pair) full duplex
Operating speed max	115.2 kbaud
Bus isolation	300VDC
Power consumption at 24V	max 50 mA
External loads	
standard loads	32 RL> 10kohm
Storage temperature range	-55 ... +80 ºC (-67 ... +176 ºF)
Max wire size	1.5 mm^2 (AWG16)

LAN Interface Module

Operating temperature range	-40 ... +60 ºC (-40 ... +140 ºF)
Storage temperature range	-40 ... +85 ºC (-40 ... +185 ºF)
Operating humidity range	5 … 95 %RH
Power consumption at 24V	max 60 mA
Ethernet type	10BASE-T 100BASE-TX
Connector	8P8C (RJ45)
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, Modbus TCP
Max number of Telnet/Modbus clients	1

WLAN Interface Module

Operating temperature range	-20 ... +60 ºC (-4 ... +140 ºF)
Storage temperature range	-40 ... +85 ºC (-40 ... +185 ºF)
Operating humidity range	5 … 95 %RH
Power consumption at 24V	max 80 mA
Supported standards	802.11b
Connector	RP-SMA
IPv4 address assignment	DHCP (automatic), static
Protocols	Telnet, Modbus TCP
Max number of Telnet/Modbus clients	1
Security	WEP 64/128, WPA2/802.11i

Data Logger Module

Operating temperature range	-40 ... +60 ºC (-40 ... +140 ºF)
Storage temperature range	-55 ... +80 ºC (-67 ... +176 ºF)
Power consumption at 24V	max 10 mA
Logged parameters	up to four with trend/min/max values for each
Logging interval	10 s (fixed)
Maximum logging period	4 years 5 months
Logged points	13.7 million points / parameter
Accuracy of the clock	better than ±2 min/year
Battery lifetime	
at -40 ... +30 ºC (-40 ... +86 ºF)	7 years
at +30 ... +60 ºC (+86 ... +140 ºF)	5 years

Spare Parts and Accessories

Information on spare parts, accessories, and calibration products is available online at www.vaisala.com and store.vaisala.com.

Table 45 Spare Parts and Accessories

Item	Order Code
MODULES	
Relay module	RELAY-1
Analog Output Module	AOUT-1
Isolated RS485 Module	RS485-1
Power Supply Module	POWER-1
Galvanic Isolation Module	DCDC-1
FILTERS	
for DMT345	
Sintered Filter AISI 316L	HM47280SP
for DMP246CS	
Sintered Filter AISI316L D=20mm	HM46780
TRANSMITTER MOUNTING ACCESSORIES	
Wall Mounting Kit	214829
Installation Kit for Pole or Pipeline	215108
Rain Shield with Installation Kit	215109
DIN Rail Clips with Installation Plate	215094
Panel Mounting frame	216038
PROBE MOUNTING ACCESSORIES	
DMT345	
Mounting Flange for D13.5mm Probe	210696
DMT346	
Cooling Set with Installation Flange	DMP246CS
Plug D13.5mm with Wire Rope	217738
Installation Flange for Cooling Set	217490
CONNECTION CABLES	
Serial Interface Cable	19446ZZ
USB-RJ45 Serial Interface Cable	219685
MI70 Connection Cable with RJ45 Connector	211339
OUTPUT CABLES for 8-pin connector	
Connection Cable 5m 8-pin M12 Female, Black	212142
Female Connector 8-pin M12 with Screw Terminals	212416
Male Connector 8-pin M12 with Cable and Adapter	214806SP
CABLE BUSHINGS	
Cable Gland M20x1.5 for 8 ... 11 mm Cable	214728SP
Cable Gland M20x1.5 for 11 ... 14 mm Cable	214729
Conduit Fitting M20×1.5 for NPT1/2 Conduit	214780SP
Dummy Plug M20×1.5	214672SP
WINDOWS SOFTWARE	
Software Interface Kit	215005
OTHER	
Calibration Adapter for HMK15 (to fit the DMT345 probe)	211302SP

Dimensions (mm/inch)

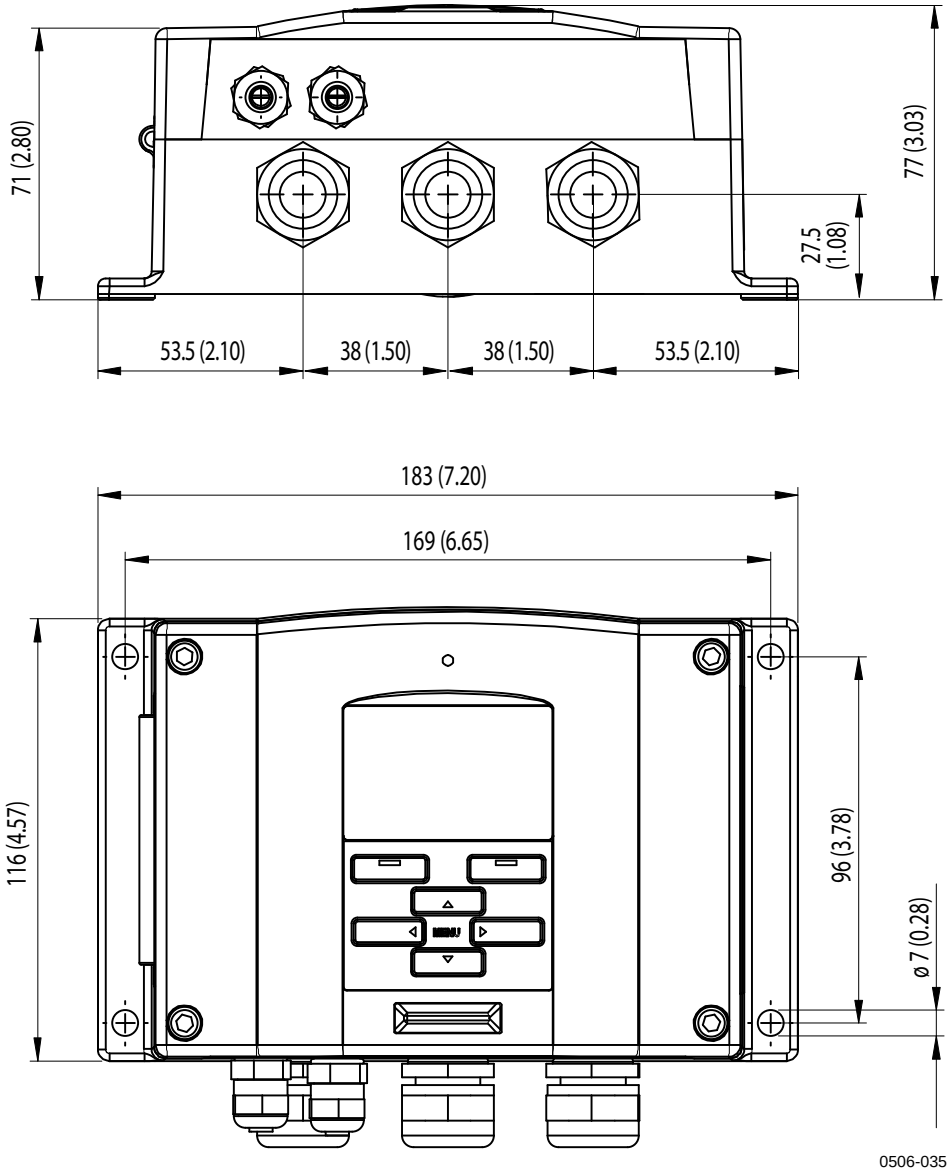


Figure 80 DMT345/346 Transmitter Body Dimensions

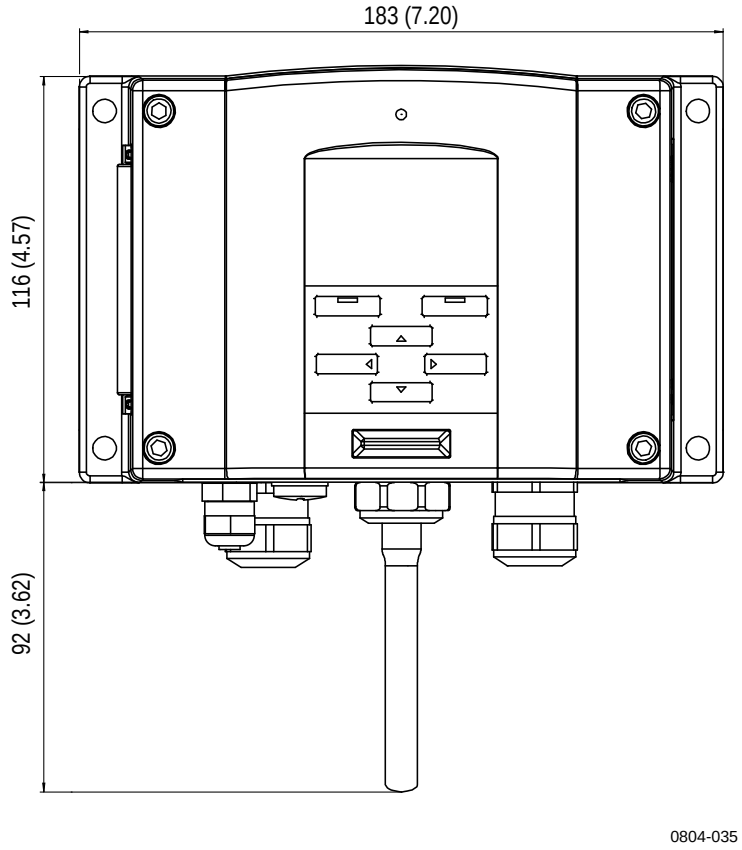


Figure 81 WLAN Antenna Dimensions

APPENDIX A
EXAMPLE INSTALLATION OF DMT346

This Appendix illustrates an example installation of DMT346 transmitter into a process.

0605-045

Figure 82 Cooling Set Installation

1. Make a round 89.5 + 0.5 mm hole on the process wall.
2. Weld the tube of the mounting flange tightly on the inner metal plate of the process wall. If the process wall is more than 125 mm thick, a lengthening piece (max. 50 mm) can be welded on the mounting tube (for walls thicker than 175 mm, see Figure 23 on page 38).
3. The cooling set is mounted in a vertical position. Tighten the screws properly in order to ensure a thermal contact.

4. Unfasten the locking screws on the cooling bar so that you can push the probe into the bar.

NOTE	Push the probe deep enough: make sure that the marking hole meets the end of the bar.

5. Lock the probe in place by tightening the locking screws on the bar.

Probe and Cooling Set Mounting with Process Shut Down

- Complete the entire mounting process as instructed on page 37.

Probe and Cooling Set Mounting with Process Running

- First mount the cooling element (and fins) to warm it up; tightly plug the hole for the probe in the cooling element for the duration of the warmup period.
- After a few hours, complete the installation by installing the probe.

This procedure should lessen the amount of condensation that builds up in the hole.

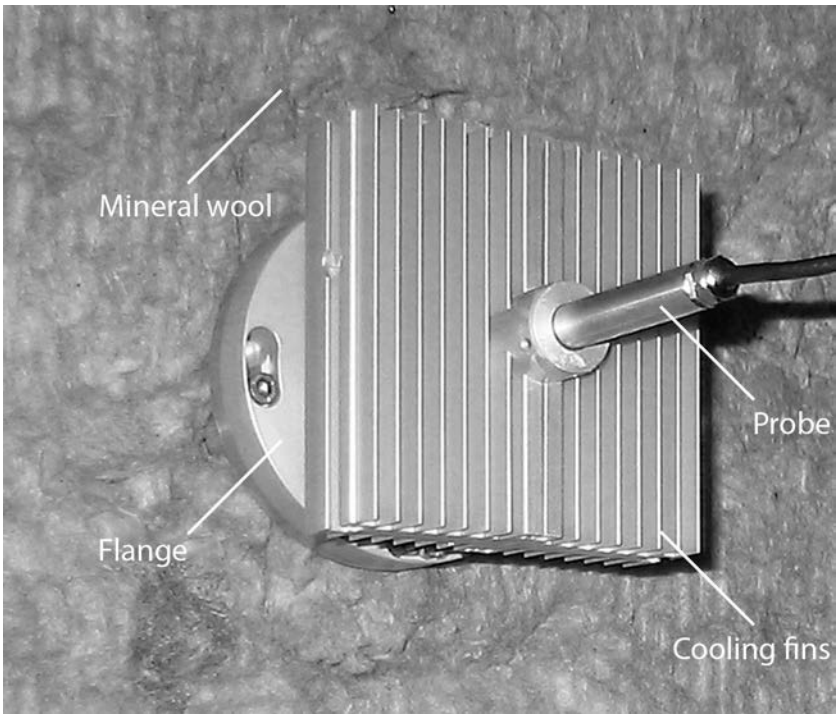


Figure 83 Insulation with Mineral Wool

APPENDIX B
CALCULATION FORMULAS

This Appendix contains the formulas used for the calculated output quantities.

The DMT346 series transmitters measure relative humidity and temperature. From these values dewpoint, mixing ratio, absolute humidity and enthalpy in normal pressure are calculated using the following equations:

Dewpoint:

$$T_d = \frac{T_n}{\frac{m}{\log\left(\frac{Pw}{A}\right)} - 1} \quad (1)$$

P_w is the water vapor pressure.The parameters A, m, and T_n depend on temperature according to the following table:

t	A	m	T_n
<0 °C[1)]	6.1134	9.7911	273.47
0 ... 50 °C	6.1078	7.5000	237.3
50 ... 100 °C	5.9987	7.3313	229.1
100 ... 150 °C	5.8493	7.2756	225.0
150 ... 180 °C	6.2301	7.3033	230.0

1) Used for frostpoint calculation if the dewpoint is negative

Mixing ratio:

$$x = 621.99 \times \frac{P_w}{p - P_w} \quad (2)$$

Absolute humidity:

$$a = 216.68 \cdot \frac{P_w}{T} \quad (3)$$

Enthalpy:

$$h = (T - 273.15) \cdot (1.01 + 0.00189 \cdot x) + 2.5 \cdot x \quad (4)$$

The water vapor saturation pressure P_{ws} is calculated by using two equations (5 and 6):

$$\Theta = T - \sum_{i=o}^{3} C_i T^i \quad (5)$$

where:

T	=	temperature in K
C_i	=	coefficients
C_0	=	0.4931358
C_1	=	$-0.46094296 \times 10^{-2}$
C_2	=	$0.13746454 \times 10^{-4}$
C_3	=	$-0.12743214 \times 10^{-7}$

$$\ln P_{ws} = \sum_{i=-1}^{3} b_i \Theta^i + b_4 \ln \Theta \quad (6)$$

where:

b_i	=	coefficients
b_{-1}	=	$-0.58002206 \times 10^{4}$
b_0	=	0.13914993×10^{1}
b_1	=	$-0.48640239 \times 10^{-1}$
b_2	=	$0.41764768 \times 10^{-4}$
b_3	=	$-0.14452093 \times 10^{-7}$
b_4	=	6.5459673

The water vapor pressure is calculated using:

$$P_w = RH \cdot \frac{P_{ws}}{100} \quad (7)$$

Parts per million by volume is calculated using:

$$ppm_v = 10^6 \cdot \frac{P_w}{(p - P_w)} \quad (8)$$

Symbols:

T_d	=	dewpoint temperature (°C)
P_w	=	water vapour pressure (hPa)
P_{ws}	=	water vapour saturation pressure (Pa)
RH	=	relative humidity (%)
x	=	mixing ratio (g/kg)
p	=	atmospheric pressure (hPa)
a	=	absolute humidity (g/m^3)
T	=	temperature (K)
h	=	enthalpy (kJ/kg)

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APPENDIX C

MODBUS REFERENCE

This appendix describes the Modbus functions and data of the transmitter.

Function Codes

DMT345 and DMT346 support all Modbus conformance class 0 and class 1 function codes defined in Open Modbus/TCP Specification, Release 1.0.

Table 46 Supported Function Codes

Function Code	Name	Notes
01 (0x01)	Read Coils	Class 1
02 (0x02)	Read Discrete Inputs	Class 1
03 (0x03)	Read Holding Registers	Class 0
04 (0x04)	Read Input Registers	Class 1
05 (0x05)	Write Single Coil	Class 1
06 (0x06)	Write Single Register	Class 1
07 (0x07)	Read Exception Status	Class 1
08 (0x08)	Diagnostics	
15 (0x0F)	Write Multiple Coils	Class 2
16 (0x10)	Write Multiple Registers	Class 0
22 (0x16)	Mask Write Register	Class 2
23 (0x17)	Read/Write Multiple Registers	Class 2
43 / 14 (0x2B / 0x0E)	Read Device Identification	

Class 0 function codes are enough to access all measurement data and configuration settings of the DMT345/346 transmitter. In addition, all class 1 and some class 2 commands are also supported giving better compatibility and allowing more efficient communication when needed.

Modbus diagnostic and device identification data can be read out only with the function codes dedicated for those purposes (08 and 43 / 14).

Register Map

All data available via the Modbus interface is grouped in six contiguous blocks of registers as described in Table 47 below.

Table 47 DMT345/346 Modbus Register Blocks

Address	Data Format	Description
0001…0068	32-bit IEEE float	Measurement data (read-only)
0257…0290	16-bit signed integer	
0513…0517	Bit field	Status registers (read-only)
0769…0790	32-bit IEEE float	Configuration settings
1025…1035	16-bit signed integer	
1281…1288	Bit field	Configuration flags

The addresses are 1-based decimal Modbus data model addresses without the first digit (e.g. 0xxxx, 1xxxx, 3xxxx, or 4xxxx). Subtract 1 to get address field values used in Modbus Protocol Data Unit (PDU).

The register map is the same for all Modbus function codes. For example, function codes 03 and 04 return exactly same result, as do 01 and 02.

Function codes 01 and 02 return 0 if the corresponding register has value 0x0000 and 1 if the register is non-zero. Writing with function codes 05 or 15 effectively writes value 0x0000 or 0x0001 in the register(s).

Data Encoding

All numeric values are available both in 32-bit IEEE floating point and 16-bit signed integer formats.

32-Bit Floating Point Format

Floating point values are represented in standard IEEE 32-bit floating point format. Least-significant 16 bits of floating point numbers are placed at the smaller Modbus address as specified in Open Modbus TCP Specification, Release 1.0. This is also known as “little-endian” or “Modicon” word order.

NOTE Despite the specification, some Modbus masters may expect “big-endian” word order (most-significant word first). In such case, you must select “word-swapped” floating point format in your Modbus master for DMT345/346 Modbus registers.

A “quiet NaN” value is returned for unavailable values. Writing any NaN or infinite value is silently ignored. A quiet NaN is, for example, 0x7FC00000; however, the master should understand any NaN value.

NOTE A complete 32-bit floating point value should be read and written in a single Modbus transaction (e.g. function codes 05, 06, and 22 do not have an effect on floating point values).

16-Bit Integer Format

16-bit integer values are scaled to include the necessary decimals (see corresponding register table for the scaling factor). Negative values (when applicable) are represented in 2's complement (65535 = -1, 65534 = -2, etc.).

NOTE Measurement parameters with normally positive values (for example, 0 … 100 %RH) may occasionally return small negative values because of measurement inaccuracy. These negative values are returned as large 16-bit integer values (2's complement).

If the scaled value does not fit in the range 0…65535 (16-bit range), the value is "wrapped" to the range by adding or subtracting 65536 as many times as needed.

For example, mixing ratio (x) value 658.92 g/kg is returned in 16-bit integer format as 356 (0x0164). You will need to add suitable offset to the 16-bit data in the Modbus master to get valid value out:

356 (16-bit register value) + 65536 (offset) = 65892 --> 658.92 g/kg (scaled by ×0.01).

However, most of the measurement data values do not need any offset.

A zero 16-bit value is returned for unavailable values. There is no way to distinguish missing values from actual zero values if the zero value is included in the valid measurement range of the parameter.

NOTE If your Modbus master supports 32-bit floating point values, always use them instead of 16-bit integer registers.

The use of 16-bit integer values is not recommended in critical applications because you cannot distinguish true zero values from zero values generated by measurement failures.

In addition to this, 2's complement makes negative values look like large positive values, which must be taken into account when utilizing the 16-bit register values.

When writing 16-bit values in configuration registers, they are always processed as signed integers in the range of -32768…+32767. You shall

use the floating point registers to write values outside this 16-bit signed integer range. Maximum writable value is 32767 also for configuration registers that do not accept negative values.

Measurement Data (Read-Only)

Table 48 Measurement Data Registers

Name	Float	Integer	Unit
RH	0001…0002	0257 (×0.01)	%
T	0003…0004	0258 (×0.01)	°C
T_d	0007…0008	0260 (×0.01)	°C
$T_{d/f}$	0009…0010	0261 (×0.01)	°C
$T_{d/f}$ (atm)	0011…0012	0262 (×0.01)	°C
T_d (atm)	0013…0014	0263 (×0.01)	°C
a	0015…0016	0264 (×0.01)	g/m³
x	0017…0018	0265 (×0.01)	g/kg
T_w	0019…0020	0266 (×0.01)	°C
H_2O	0021…0022	0267 (×1)	ppm_V
p_w	0023…0024	0268 (×0.1)	hPa
p_{ws}	0025…0026	0269 (×0.1)	hPa
h	0027…0028	0270 (×0.01)	kJ/kg
ΔT	0031…0032	0272 (×0.01)	°C
a_{NTP}	0033…0034	0273 (×0.01)	g/m³
SSR	0037…0038	0275 (×0.01)	%
T_s	0039…0040	0276 (×0.01)	°C
H_2O	0065…0066	0289 (×1)	ppm_W

Available measurements depend on the instrument configuration. Values may be unavailable also in case of device failure. Read status registers or exception status outputs to check for failures.

NOTE Only real-time data can be read from the instrument. Data that is recorded in the transmitter's memory (internal memory or data logger module) cannot be read through Modbus.

Status Registers (Read-Only)

Table 49 Status Registers

Name	Address	Description
Fault status	0513	1 = No errors
Online status	0514	1 = Online data available
Error code (bits 15…0)	0516	Bit field that represents the error codes listed in Table 33 on page 147. Active errors are set to 1. For example, if bit 14 is set to 1, error code E14 is active.
Error code (bits 31…16)	0517	

Error information can retrieved also with function code 08, sub-function 02.

NOTE Basic status information of the DMT345/346 transmitter is also available with the Read Exception Status function code 07. For details, see section Exception Status Outputs on page 182.

Configuration Registers

Configuration parameter registers are used to configure the measurement. Writing out-of-range values is silently ignored.

Table 50 Configuration Parameter Registers

Name	Float	Integer	Valid Range
Pressure setting default value	0769…0770	1025 (×1)	0…9999 hPa
Pressure setting temporary value	0771…0772	1026 (×1)	0…9999 hPa
Sensor purge interval	0773…0774	1027 (×1)	10…2880 min
Molecular weight for ppm_w calculation	0775…0776	1028 (×0.001)	0…999.999 g/mol

If you modify the pressure setting repeatedly, modify the temporary value at register 0771...0772 (1026) instead of the permanent setting at register 0769…0770 (1025). Set the temporary value to zero to return to the default pressure setting.

Non-metric units are not available on Modbus. If they are needed, calculate the conversion outside the transmitter.

Configuration flags are used to select some basic options of the instrument and to manually start the sensor operations.

Table 51 Configuration Flag Registers

Name	Address	Description
Standard filtering on/off	1281	1 = Filtering on
Extended filtering on/off	1282	1 = Extended filtering on
Automatic sensor purge on/off	1283	1 = Automatic purge on. See configuration register 0773…0774 (1027).
Start-up sensor purge on/off	1284	1 = Start-up purge on
Sensor purge in progress	1285	1 = Purge in progress (write 1 for manual start)
AutoCal in progress	1286	1 = AutoCal in progress (write 1 for manual start)

Flags 1281 and 1282 are mutually exclusive.

Some of the configuration registers might not have an effect depending on the instrument model and configuration.

Other configuration settings are not usually needed and are not available using the Modbus interface. The service cable must be used to change other configuration settings if needed.

Exception Status Outputs

Exception status outputs (read with function code 07) tell the summary of the transmitter status as described in Table 52 below.

Table 52 Exception Status Outputs

Output	Name	Description
0 (0x01)	Fault status	1 = No errors
1 (0x02)	Online status	1 = Online data available

Status information is available also with register access; see section Status Registers (Read-Only) on page 181.

Diagnostic Sub-Functions

DMT345/346 support some of the Modbus diagnostic functions described in the Modbus Application Protocol Specification V1.1b. These diagnostic functions are accessed with function code 08. See Table 53 below for details.

Table 53 Modbus Diagnostics

Code	Sub-Function Name	Notes
00 (0x00)	Return Query Data	
01 (0x01)	Restart Communications Option	Cancels the “Listen Only” mode. Data field must be set to “00 00” for Restart Communications Option. Sub-Function 01 with data field “FF 00” is rejected.
02 (0x02)	Return Diagnostic Register	Non-zero if there are active transmitter errors. For same error information, see status registers 0516 and 0517. The value of the Diagnostic Register is a logical OR of these two status registers.
04 (0x04)	Force Listen Only Mode	Puts device “off-line”
10 (0x0A)	Clear Counters and Diagnostic Register	Diagnostic Register cannot be cleared
11 (0x0B)	Return Bus Message Count	Total number of messages seen on the bus/interface
12 (0x0C)	Return Bus Communication Error Count	Number of messages with bad Modbus RTU CRC or Modbus TCP frame
13 (0x0D)	Return Bus Exception Error Count	Number of Modbus exception responses sent
14 (0x0E)	Return Slave Message Count	Number of Modbus messages processed
15 (0x0F)	Return Slave No Response Count	Number of Modbus messages received without sending a response. This happens for received broadcast messages (Modbus RTU only) or when DMT345/346 is in the “Listen Only” mode.

Although Modbus Diagnostics are standardized only for serial line devices, DMT345/346 supports the same diagnostic functions also on Modbus TCP.

NOTE Resetting, powering up the transmitter, or reselecting the Modbus mode (by serial command or with the user interface) resets all Modbus diagnostic counters and cancels any “Listen Only” mode.

Device Identification Objects

DMT345/346 Modbus conforms to the extended identification level defined in the Modbus Application Protocol Specification V1.1b. Both stream access and individual access to the objects is supported.

Table 54 Modbus Device Identification

Object Id	Object Name	Description
0x00	VendorName	“Vaisala”
0x01	ProductCode	Product code (e.g. “DMT340”)
0x02	MajorMinorVersion	Software version (e.g. “5.10”)
0x03	VendorUrl	“http://www.vaisala.com/”
0x04	ProductName	Product name of the instrument
0x80	SerialNumber	Serial number (e.g. “D0610020”)
0x81	CalibrationDate	Date of the last calibration (e.g. “2011-03-01”, empty if not available)
0x82	CalibrationText	Information text of the last calibration (empty if not available)

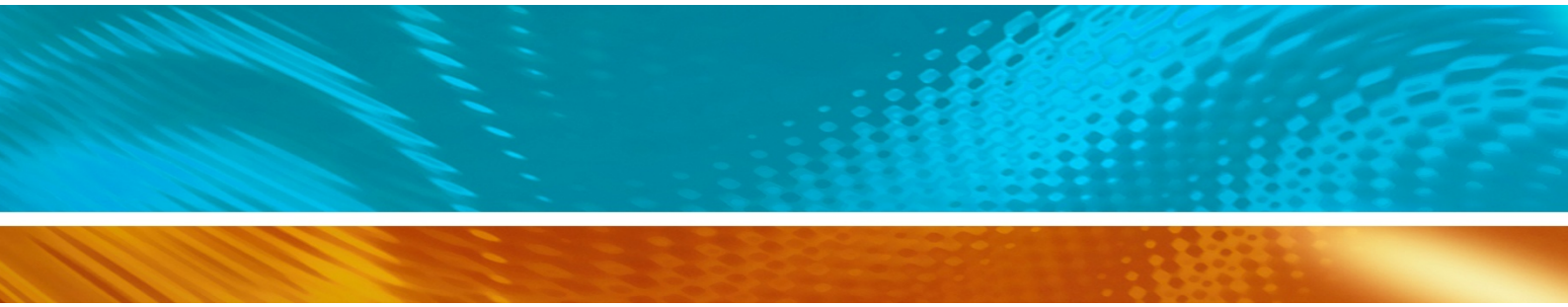
Exception Responses

Exception responses from the transmitter are according to the Modbus Application Protocol Specification V1.1b.

Table 55 Modbus Exception Responses

Code	Name	Reason
01	ILLEGAL FUNCTION	Unsupported function code
02	ILLEGAL DATA ADDRESS	Address out of valid ranges
03	ILLEGAL DATA VALUE	Otherwise invalid request

Accessing unavailable (unsupported or temporarily missing) registers inside ranges specified in Table 48 does not generate an exception. “Unavailable” value (a quiet NaN for floating point data or zero for integer data) is returned instead. An exception is generated only for any access outside the register blocks defined in section Register Map on page 178.



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